CANADIAN GEOGRAPHICAL JOURNAL

APRIL
1939

VOL. XVIII
NO. 4

35c A COPY

$3.00 A YEAR

Cabinets and Kitchen Queen Cabinet Sink by Crane Limited *Field: Marble Tile Inlaid No. 8060. Border: Marboleum M / 54 and M 41*

DOMINION *Inlaid* LINOLEUM

Let's peep into the room above! The *floor* attracts your eye at once! Its distinctive Marble Tile pattern with bright cheery colours gives the decorative keynote for the entire room. There's matching green Marboleum on the cabinet tops and surrounding walls, bound to the cabinets with neat metal stripping, and *curved* up the walls in the form of a cove base to eliminate dirt and moisture collecting in cracks and corners. MUROLEUM No. 811, in a colour that blends with the floor, covers the walls including those of the cosy breakfast nook! Yes, it *is* a joy to work in a time-saving, *beautiful,* easy to-clean kitchen. Ask any architect or flooring contractor about our 5-year guarantee.

Write for booklet on "The Care of Linoleum".

DOMINION OILCLOTH & LINOLEUM COMPANY

LIMITED **MONTREAL**

HAWKING—
THE DEPARTURE

A Famous Sporting Print engraved by R. G. Reeve

TINS OF 50—55¢

FALCONRY has fascinated both men and women for some 4000 years. The sportsman of the Middle Ages pledged himself by his hawk, his hound and his lady fair—each held a cherished place in his esteem.

Today, Wills's Gold Flakes hold a cherished place in the esteem of English men and women alike . . . they are "the man's cigarette that women like." Both appreciate the high quality of their top-grade Virginia leaf, well and firmly rolled in pure white Velin paper—both prefer their distinctive personality and flavour. So Gold Flakes are long-standing favourites throughout the Empire in those circles where exacting smokers put quality above price.

W. D. & H. O. WILLS'

GOLD FLAKE

Plain or Cork Tip **CIGARETTES**

A shilling in London — a quarter here

THE SMOKE OF THE BRITISH EMPIRE

Photo by W. J. Brown, member of staff of Bank of Montreal.

Spring — bringing new life, new hope — the season of rebuilding and renewal. Everywhere throughout the country, Canadian property holders — private home owners, landlords, farmers — are once again improving their properties with the aid of loans from the Bank of Montreal under the Home Improvement Plan. You are invited to consult with the manager of our branch in your city or town.

CANADIAN GEOGRAPHICAL JOURNAL

Editor - Gordon M. Dallyn

172 WELLINGTON STREET, OTTAWA

This magazine is dedicated to the interpretation, in authentic and popular form, with extensive illustration, of geography in its widest sense, first of Canada, then of the rest of the British Commonwealth, and other parts of the world in which Canada has special interest.

Contents

APRIL 1939 VOLUME XVIII No. 4

COVER SUBJECT:—Seven-foot cutter bar of traction trailer mower. Equipment of this character enables large crops of hay to be cut in a relatively short time.

PAGE

IMPLEMENTING AGRICULTURE by J. FERGUS GRANT 171

Title for Pages 186 and 187—The modern combine gathers the golden resources of Canada's wheat fields.

Map of the world, in colour, indicating the extensive foreign markets of agricultural implements, with flags and currencies of each country. 193-198

NEW WHEAT CREATIONS AND THEIR SIGNIFICANCE TO CANADA by L. H. NEWMAN 208

INSECTS AS A FACTOR IN WHEAT PRODUCTION ON CANADIAN PRAIRIES by H. G. CRAWFORD 217

EDITOR'S NOTE-BOOK X

• • • •

The British standard of spelling is adopted substantially as used by the Dominion Government and taught in most Canadian schools, the precise authority being the Oxford Dictionary as edited in 1936.

Contents of this Journal are copyright.

The Canadian Geographical Journal is printed in Canada by the Canadian Printing and Lithographing Company, Limited, Montreal, for the proprietors, The Canadian Geographical Society, and published by the Society at 2151 Ontario Street East, Montreal, Canada.

Address all communications regarding change of address, non-delivery of Journal, etc., to the publication office, 2151 Ontario Street, East, Montreal, Canada, giving old and new address. On all new memberships, the expiry date will be printed on wrapper containing starting number. This will constitute a receipt for subscription.

Member Audit Bureau of Circulations.

Membership fee is $3.00 per year in Canada and other parts of the British Empire, which includes delivery of the Journal, postpaid; in United States, Mexico, France, Spain, Central and South America, $3.50; in other countries, $4.00. Make membership fee payable at par in Ottawa.

Special Representatives:

Ontario: F. A. Dallyn, 20 King Street, E., Toronto. (Tel. EL. 2863)
Quebec: J. Fergus Grant, 1390 Sherbrooke Street, W., Montreal. (Tel. HA. 3047 or FR. 1722)
Eastern United States: Wells Constantine, 116 East 16th St., New York, N.Y. (Tel. ST. 92929)
Europe: Harper Cory, Foxburrow Lodge, Harestone Valley, Caterham, Surrey, England, (Tel. CA. 2144)

Entered as second-class matter at the Post Office, Montreal, Canada.

IMPLEMENTING AGRICULTURE

by J. FERGUS GRANT
Staff Correspondent

WHEAT is the commodity that has secured for Canada her greatest international reputation, though many other products of the field, forest and factory, the mine and streams influence materially the internal economy of this Dominion. Methods whereby field crops are cultivated, and the manufacture of equipment that enables these to be harvested most efficiently constitute a subject of considerable importance to all Canadians. But, the contribution of this country to the betterment of conditions and an enhanced standard of living is not confined to its nine provinces. The results of research undertaken here are communicated to all corners of the world, whether in the form of wheat and flour that can produce a better quality loaf of bread, or in the nature of machinery that will provide for more efficient production in other lands.

Agricultural production has made slow progress down through the ages, and only by the exercise of continuous toil has man resident in temperate climes been able to glean a living from the soil. Implements that are now considered crude once lightened somewhat the labour involved, and during the past century mechanical advances have introduced an era of emancipation. Power machinery now enables the farmer to derive the fullest measure of return from his acres, and a higher standard of living is being created for all members of the community, whether urban or rural. By reason of our great diversity of agricultural enterprise, and the fact that two-thirds of the field-crop area of this country is concentrated in the three Prairie Provinces, it was natural that leadership should be provided by Canadians during this remarkable period of development. New equipment of a more efficient character was developed, thus facilitating the cultivation of wider areas on an economic basis. Railways were

Left:—Canada's hay and clover crop, amounting in 1937 to 13,030,000 tons valued at $97,309,000, and third in importance among Canadian field crops to wheat and oats. Quebec and Ontario each accounted for one-third of the total production, but machinery assisted the other seven provinces in garnering this rich harvest.

Seven stages in the development of the binder: 1. Primitive sickle. — 2. Cradle, utilizing scythe blade. — 3. The knife bar, in sections, with table attached. — 4. Reel added to knock down grain. — 5. Hand rakes and reel are eliminated by the automatic self-rake reaper. — 6. Elevator carriers transfer grain to the hand binder on a second platform. — 7. Mechanical knotter introduced, twine replacing the wire that damaged threshing machines after its first appearance.

extended westwards to serve the expanding granary of the Empire, there was a spectacular increase in population, and employment was provided throughout the Dominion by a large variety of enterprises associated with the development of agriculture.

Louis Hébert First Farmer

Cultivation of Canadian soil by the white man dates from 1605, when some vegetables were grown at Annapolis, Nova Scotia, but to Louis Hébert goes the credit of being the first Canadian farmer. Landing in 1617, he cleared a plot of land in what is now the upper section of Quebec City, an axe and a spade being his only tools. Other "*habitants*" joined this pioneer, and in half-a-century some 11,000 acres were under cultivation. The advent of United Empire Loyalists and other settlers raised the rural population, and in 1871 the first census recorded 1,646,781 acres under wheat, 3,650,419 acres under hay, and 403,102 acres under potatoes in Nova Scotia, New Brunswick, Quebec and Ontario. Wheat ranked second to oats with a yield of a mere 16,723,873 bushels, and for ten years after Confederation in 1867 the crop seldom, if ever, exceeded 25 million bushels. Home production failed to meet domestic requirements, in fact, and imports of wheat and flour were nearly nine million bushels in excess of exports. By 1898, only forty years ago, the annual yield reached fifty million bushels. A new record of 567,000,000 bushels was achieved in 1928. The production of oats increased from 42,489,000 bushels in 1870 to a peak of 564,000,000 bushels in 1923. That of barley advanced from 11,496,000 bushels in 1870 to 136,391,000 bushels in 1928. The rye crop, which totalled 1,064,000 bushels in 1870, attained its highest production in 1922 with 32,373,000 bushels.

Agriculture occupies a paramount position in the national economic structure, attained largely through the help of those engaged in the manufacture of farm implements, and the co-operation of their representatives in the field with the men whose requirements they seek to serve on the farm. Geographically, therefore, the implement industry is closely identified with all nine provinces, and their respective problems involve special consideration in the design and production of equipment.

Certain sections of the Maritime Provinces are especially adapted to the cultivation of potatoes and apples, though hay and clover are grown in large volume, and dairy farming has been widely developed. A very large proportion of the field-crop acreage in Quebec and Ontario is planted to forage and coarse grains, and each produces tobacco. Whereas Quebec is responsible for most of the maple syrup in Canada and much of the honey, Ontario is well suited to the cultivation of fruit, truck crops, sugar beets and even cereals, while dairy farms prosper in the vicinity of urban centres. Wheat production predominates in the southern short-grass plains, extending from the Red River Valley of Manitoba to the foothills of Alberta, but mixed farming prevails in the park belt to the north of that region, large areas of coarse grains and natural hay being used for live-stock feeding. Highly specialized fruit and vegetable farms range through the Okanagan and Kootenay Valleys in British Columbia, while Vancouver Island and the lower Fraser Valley are noted for poultry and dairy products.

Machinery Vital Factor

Climatic conditions over which the farmer has no control render the production of wheat an important factor in the crop programme throughout a large part of Western Canada, and will so remain despite the realization that crop diversity is desirable as a stabilizing influence. The implement industry has a definite relationship with this situation, as indicated by Dr. J. F. Booth, Associate Director of Marketing, Dominion Department of Agriculture, in a statement before the Special Committee of the House of Commons on Farm Implement Prices. "The expansion of grain production in Western Canada has been made possible in very large measure by the development and introduction of machinery suitable to large scale production", he said. "When new equipment or new methods are introduced, farmers must of necessity purchase such equipment or cease farming. Competition makes this inevitable. Agriculture is no different in this respect to other industries".

The following table illustrates the increasing employment of agricultural machinery in Canada during less than half-a-century, the census figures recording the value of that in operation on farms throughout the Dominion in the years noted:

Year	Total Value
1885	$ 46,569,725
1895	50,944,385
1901	108,665,502
1911	257,007,546
1921	665,180,416
1931	650,664,000

The provincial distribution, according to the 1931 census, is as follows:

Provinces	Value	Per cent of total
Saskatchewan	$185,510,000	28.5
Ontario	151,928,000	23.4
Alberta	116,301,000	17.9
Quebec	97,270,000	14.9
Manitoba	54,847,000	8.4
New Brunswick	13,252,000	2.0
British Columbia	12,886,000	2.0
Nova Scotia	10,554,000	1.6
P.E.I.	8,116,000	1.3
	$650,664,000	100.0

It is interesting and worthy of note, however, that approximately nine cents in every dollar paid by the western farmer for his machinery represent freight charges, as compared with four cents in every dollar paid by the farmer in Eastern Canada. Also, shipments of implements, machines and parts from the manufacturing district of the United States in and around Chicago to Western Canada are from six to nine per cent higher than the corresponding rates from the manufacturing district of Eastern Canada.

Notable Economies Effected

Every effort is being made to assist the farmer, and close co-operation is maintained between the engineering force in the factory and its field staff. Notable economies have been effected in recent years through the creation of a machine that combines in a single operation those of ploughing, harrowing, cultivating and seeding. This is known as the one-way disc seeder, which has been found particularly suitable in districts subject to adverse conditions, such as drought and soil drifting. The surface sweep of the wind is destructive, especially in Southwestern Manitoba, Saskatchewan and Southern Alberta, where this machine mixes the surface soils with the stubble and provides a resistant seed bed that holds together with greater tenacity than is possible through previous tillage methods.

The cost of tillage per acre is materially reduced, a definite advantage when Canadian farmers are faced with the competition of other countries in which cheap labour prevails. Tilth is greatly improved, the seed being deposited in the moist earth simultaneously with the preparation of the land, while weeds are cut

and thrown to the surface, there being killed by exposure to the sun.

The speed of the combined operations enables a large area to be seeded at an early date, wheat and other grains being brought to maturity before damage is caused by frost and through other fall hazards. Furthermore, a larger yield may be secured per acre. Smaller machines of this type, to be drawn by a tractor or horses, are being manufactured for use throughout Ontario, Quebec, the Maritimes and British Columbia, where their special characteristics are similarly appreciated. With a single sweep across farm territory, a tremendous reduction has been effected in the costs involved by the four-fold operation of ploughing, harrowing, cultivating and seeding, as compared with the methods prevailing before the advent of the present revolutionary equipment.

Another multiple unit has increased considerably the efficiency of harvesting. This is the combine, which reaps and threshes grain in a single operation. Nine thousand such machines were shown by the 1931 census returns to be in use throughout this Dominion, but the production of even more efficient models since then has resulteb in their utilization over a wider area, including farm territory other than that on the prairies. Furthermore, the compact combine made available last year could be purchased for only $950, as compared with an investment of approximately $2,450 for the large machine previously offered with practically the same capacity.

Labour costs have been reduced, and Canada no longer witnesses heavy seasonal movements of harvesters. With the binder-thresher method, an acre could be harvested for about $2.70, this figure being reduced to $1.05 with the large combine, and to seventy cents with the small machine. The speed of operation has been increased six-fold over that involving the employment of men with binders. The harvest worker was freed of the toil of swinging "cradles" and tying sheaves of grain by hand with the advent of the binder over fifty years ago, while the thresher eliminated the tedious practice of beating with a flail. Both increased the efficiency of production, but the combine brought a revolutionary advance to agriculture through the combination of these two operations.

The most important factor in modern farming was the introduction of the tractor, which proved its worth during the Great War, when labour was scarce. During the depression, the tractor lost favour, but modern developments have enhanced its prestige as one of the foremost aids to farming. Low pressure heavy rubber tires save dollars and cents in the provision of better traction, cut fuel and repair costs, and enable the farmer to travel in greater comfort at faster speeds over his land or along the roads. Just as the automobile offers greater attractions to its urban owner, the tractor of this day and age is being more widely welcomed by agriculture, many of the power demands of which it is also meeting. Comparative figures illustrating the acreages covered and the costs of field operations with horses and tractors have been compiled by the Dominion Experimental Farm for Eastern Canada, and represent the experience of some two hundred tractor owners, as follows:

ACREAGES COVERED PER TEN-HOUR DAY

	HORSES			TRACTOR	
	2-horse Team	3-horse Team	4-horse Team	2-plough Tractor	3-plough Tractor
Ploughing..	1.5	2.0	3.0	5.2	6.7
Disking....	7.0	9.0	12.0	16.3	18.9
Cultivating.	8.0	10.0	15.0	18.1	18.7
Harrowing..	13.0	17.0	....	26.5	26.8

COSTS PER ACRE—EASTERN CANADA

	HORSES			TRACTOR	
	2-horse Team	3-horse Team	4-horse Team	2-plough Tractor	3-plough Tractor
Ploughing..	$3.33	$3.00	$2.33	$1.65	$1.52
Disking....	.71	.66	.58	.53	.54
Cultivating.	.62	.60	.46	.48	.55
Harrowing..	.38	.35	...	.33	.38

When the potentialities of the tractor are fully utilized—larger implements now available being used, or the effective tandems, hitches and combinations made popular by recent developments employed —the cost of preparing a seed-bed can be still further lowered.

Other major items of machinery in operation on farms throughout the Dominion include 431,403 binders (129,177 in Saskatchewan and 124,561 in Ontario), 4,805 headers, 105,555 threshing machines (39,575 in Quebec and 27,046 in Saskatchewan), 431,243 cream separators (127,788

Left top:—The hand plough is still popular on small farms.

Left centre:—A two-horse corn cultivator.

Left bottom:—Manure spreader provides uniform distribution.

Now only a memory — the "cradle" of olden days.

in Ontario and 76,024 in Saskatchewan), 6,419 milking machines, of which 4,015 are in Ontario; 179,765 gasoline engines, 105,360 tractors (43,308 in Saskatchewan, 23,985 in Alberta and 18,993 in Ontario), 18,639 electric motors, of which 9,604 are in Ontario; 48,401 motor trucks (14,586 in Ontario and 10,938 in Saskatchewan), 321,284 automobiles (125,716 in Ontario and 65,094 in Saskatchewan). These figures are interesting, as they reveal to what extent the agricultural community of the country is dependent on mechanical equipment, the figures being much higher than one would imagine.

Further equipment demands have been made by agriculture during the past decade with the disappearance of obsolete methods of production. These have been met by the manufacturers through their design of special apparatus for the efficient cultivation of fruit, vegetables of various kinds for immediate sale or for disposal to canning plants, tobacco and sugar beets.

The following brief list provides some conception of the wide variety of machinery and implements of a major character made available for the modern farmer, many of these being illustrated in the accompanying photographs: Grain binders, dump carts, harrow carts, cream separators, tobacco and corn cultivators, spring-tooth cultivators, stiff-tooth cultivators, ensilage cutters, feed cutters, potato diggers, one-way discs, cultivator drills, fertilizer drills, grain drills, gasoline and kerosene engines, grinders, disc harrows, spike-tooth harrows, spring-tooth harrows, corn harvesters, push harvesters, cylinder hay loaders, rake bar hay loaders, mowers, land packers, maize planters, potato planters, ploughs, pulpers, soil pulverizers, rakes, side delivery rakes, reapers, land rollers, saw outfits, scufflers, seeders, sleighs, fertilizer sowers, turnip sowers, orchard sprayers, potato sprayers, manure spreaders, swathers, tedders, threshers, reaper-threshers, tractors, transplanters, waggons, rod weeders and wheelbarrows.

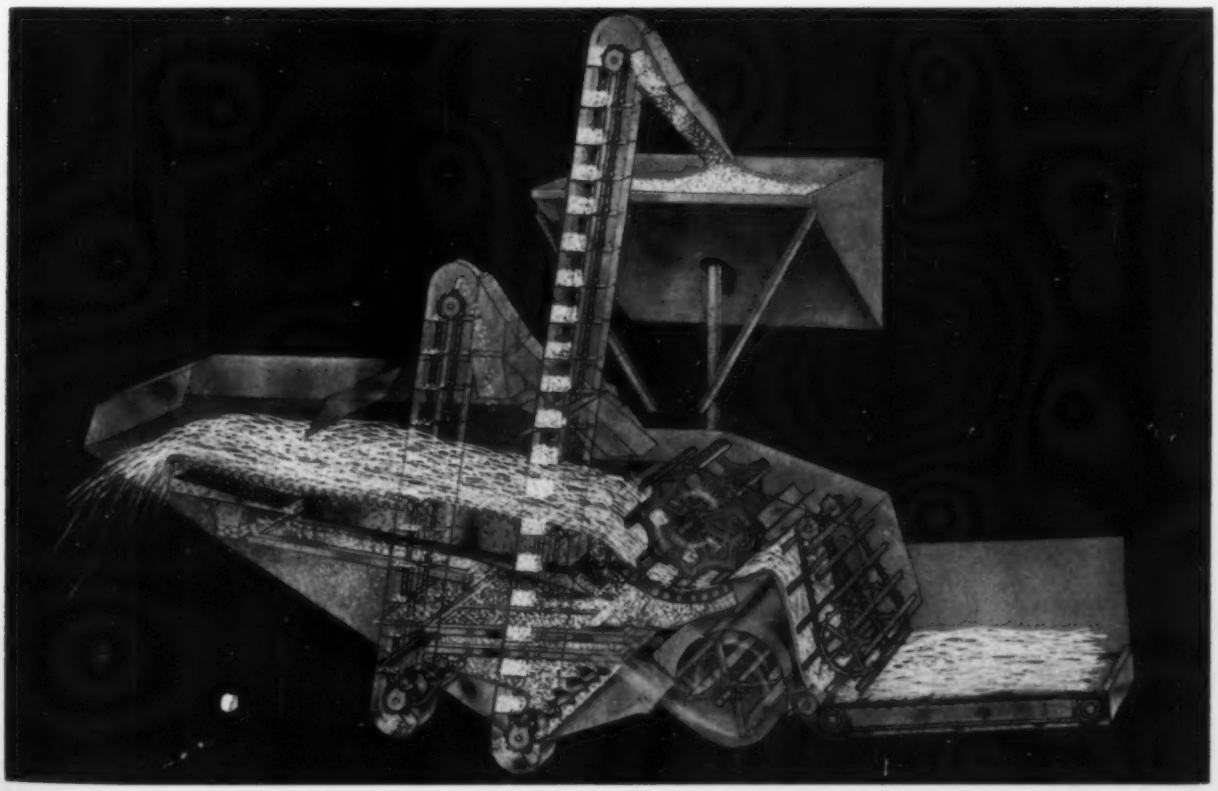
Electricity Used Extensively

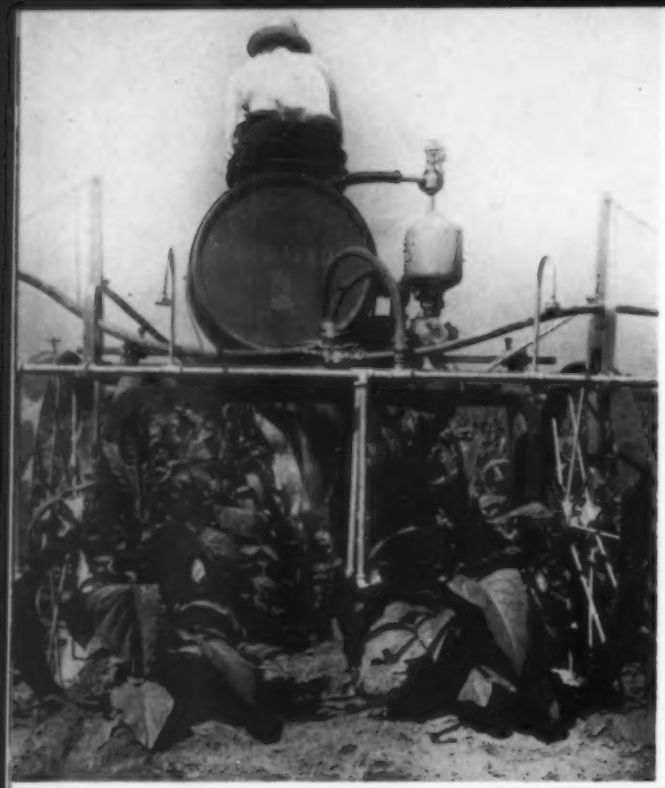
As a further indication of the material progress achieved in the provision of farm facilities, reference may here be made to the extensive electrification of agricultural areas in Ontario by the Hydro-Electric Power Commission. Of rural consumers of power in 1937, a survey indicated that 75.31 per cent had electric hand irons, 68.52 per cent electric radios, 57.54 per cent electric washing machines, 52.37 per cent electric toasters, 16.97 per cent electric ranges, 14.72 electric water pumps, and 9.94 per cent electric refrigerators. Power is being supplied to 45,900 farms, and it is expected this total will be increased by nearly 7,000 this year.

Radio is becoming ever more important as an aid to agriculture, besides providing entertainment and a liberal education to those who tune in on the aerial waves. Much interest should be aroused, therefore, in an announcement by a leading Canadian company of the recent production of a radio that may be operated at a low cost with a diminutive battery. No longer will it be necessary to procure expensive batteries for the operation of a radio in locations far removed from power lines, which should prove of considerable benefit to farmers so situated. Some satisfaction may be obtained even out in a drought-stricken area from a symphony composed by Mozart on the banks of the Danube, and played by a famous orchestra in some large city. The rural isolation that has driven countless farmers to the cities is rapidly disappearing, and the radio may contribute to the return of many persons now confined within depressing tenements, offering them the greater advantages of wide open spaces with many of those attractions to which modern civilization has become accustomed.

Stream-lined "Clipper" combine in service on a farm in Eastern Canada.

Sectional view of a small combine, which illustrates the inflow at right, the threshing, separation and elevation of grain to its tank, and the outflow of straw at left.





Left:—Traction sprayer with twelve nozzles provides rapid distribution of spray for protection against parasites.

Below:—Two-furrow gang plough breaks up the land for cultivation.

Above:—Spring-tooth cultivator prepares a seed bed.

Right:—Agriculture is served by a variety of implements and traction vehicles. The primitive and modern are here represented by a yoke of oxen and a wheel guide cultivator.

Where five tillage operations are combined; those of ploughing, cultivating, harrowing, seeding and packing are performed with this power-farming equipment.

The printing press, supported by telegraph, telephone and radio services, enables the farmer to secure the latest information concerning crop and other conditions in his own and other countries. The Dominion Bureau of Statistics is enabled to compile and distribute reports pertaining to stocks of wheat and other grain in elevators throughout the country, Canadian wheat in United States ports, overseas export clearances, world shipments of wheat and wheat flour, the number of railway cars unloaded at terminal elevators, the various grades of Canadian and also foreign grain in store, with its location, the daily quotations and weekly averages of cash grain by grades on the Winnipeg and Toronto markets, and even the number of railway cars inspected each month. Newspapers and grain brokers supplement this information. Further assistance is rendered to the farmer by the various Departments of Agriculture, which are engaged in research, and by the Dominion Meteorological Bureau, which provides data that enables them to derive the fullest advantage from weather forecasts.

Massey and Harris Pioneers

While statistics reveal remarkable achievements, figures alone fail to portray the real romance with which agricultural advances have been associated in Canada. For more than ninety years the human element has enriched the industry of a large organization on whose activities the sun never sets and which may well serve as an illustration of efforts made to implement agriculture in this country. Daniel Massey and Alanson Harris laid the foundations in 1847 and 1857 respectively of a union that was not consumated, however, until 1891 with the formation of the

Massey-Harris Company, Limited, which transacts business in fifty-three different countries, operates four factories in Canada, two in the United States, and one each in France and Germany. So extensive are its operations in the foreign field, illustrated in the accompanying map, that the expenditure of this firm in Canada between 1928 and 1937 actually exceeded by $21,261,763 its total sales for that period in the Dominion.

Contributions to the national economy during this ten-year period included payment of $2,741,279 covering duties on imported materials, federal, provincial and municipal taxes, $9,564,485 for freight transportation and $3,460,895 for travelling expenses, $31,510,330 in salaries and wages, $10,237,934 in commissions to dealers, $1,179,612 for pensions and grants to employees and retiring allowances, $105,809 for donations to charities, and $21,150,568 for materials and services secured in Canada.

In reverting to the early days of this implement industry, the "cradle" is found within the shadow of a modern "combine". The former, which comprised a framework of four wooden fingers and a blade, was the sole practical reaper in operation here one hundred years ago. Two men, the second with a wooden rake, were able to cut and bind between three and four acres of good grain per day with this equipment. It was natural that Daniel Massey, energetic and ambitious, should seek some means whereby production on his own and other farms might be increased. From the vicinity of Cobourg, Ontario, where his fields had been cleft from the bush and cultivated successfully, he moved to Newcastle and established a small foundry and machine shop. Here were produced ploughs, scufflers, maple sugar kettles and repair parts for primitive threshers, all of which assisted the new settlers in subduing the wilderness and in

As a tillage machine, the one-way disc creates a matted, stubble-bound surface that successfully withstands soil drifting.

penetrating the hinterland. Hart Almerrin Massey, for whom "Hart House" and "Massey Hall", in Toronto, were named, joined his father in 1851. As a young lad, he had driven oxen, cut and hauled cordwood, tramped three miles to a log schoolhouse in the bush, teamed in a lumber camp, hauling logs to the lake front and mill, fired in the Cobourg tannery, attended Victoria College, and at the age of twenty-one took charge of his father's farm, on which he was born in 1823.

The firm of H. A. Massey & Company enjoyed a period of remarkable development, producing in 1852 the "Ketchum" mower, which was followed by the "Burrell" reaper, the "Manney" combined hand-rake reaper and mower, the famous "Woods" mower, and in 1863 by the "Woods" self-rake reaper, recognized as the first self-rake harvester to be manufactured in this country. Equipment was exported to Germany previous to the Franco-Prussian War, and in 1870 the company was incorporated as the Massey Manufacturing Co., with head offices in Toronto. A catalogue of 1887 contains the following observation: "We have, this year for the first time completed a systematic and efficient organization in Great Britain and on the Continent for the wider distribution of our goods. In England, Scotland, Ireland, France, Germany, Belgium, Russia, Asia Minor, South Africa, South America, the West Indies and Australia, our machines are at work, and during the past season have given remarkable satisfaction".

Another pioneer, Alanson Harris, commenced the manufacture of revolving hay-rakes in a little old shop at Beamsville, in the Niagara Peninsula, in 1857. His son John was a natural mechanic and inventor, and the Harris firm soon produced mowers, hand-rake reapers, root-cutters, clover-threshers, corn-shellers and ploughs. Ten years after its establishment, the firm of A. Harris Son & Co. moved to Brantford, where the famous "Kirby" reaper was developed. The demand for self-rake reapers came from Ontario, Quebec and the Maritime Provinces, but these found their way into the prairies, despite the competition of American firms with a geographical advantage, even before the

Left:—Power-take-off mower, driven by a shaft from the tractor, is one of the most recent farm implements.

transcontinental railway was constructed. When, in 1884, the Canadian Pacific Railway reached what is now Qu'Appelle, near Regina, Harris machines were shipped three hundred miles north to Prince Albert in Red River carts.

Honours Won for Canada

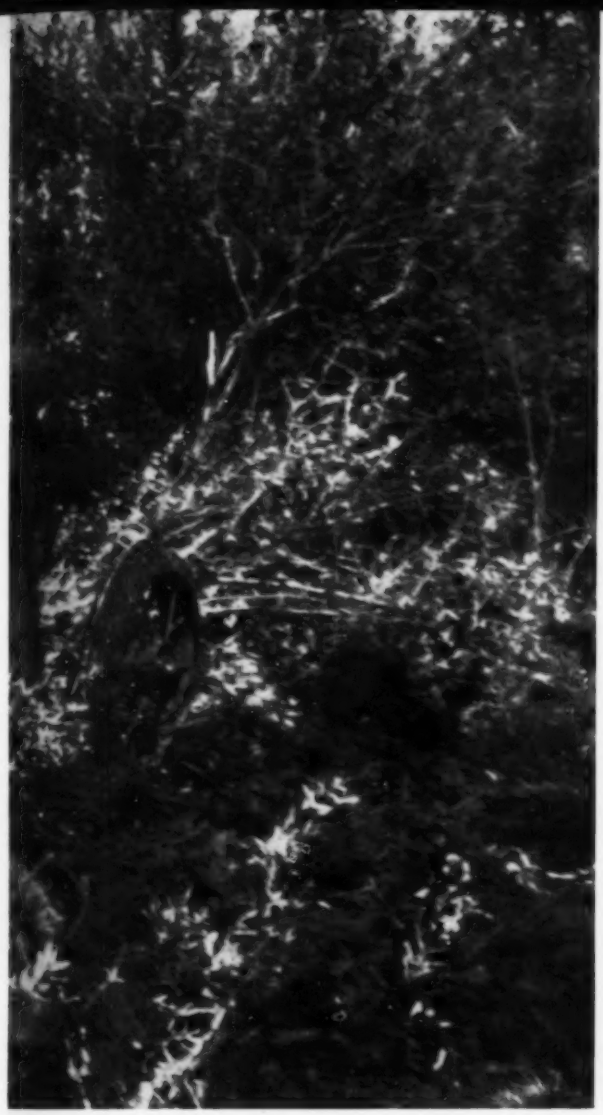
Both companies achieved notable success during the years immediately preceding their union in 1891. During Confederation Year, the Massey firm represented Canadian manufacturers at the Paris Exposition, and won the highest gold medal for its reaper and mower, followed by a large number of international awards and prizes for field trials in this country. The name of Harris was likewise held in high esteem at home and abroad, extending its reputation over as wide a radius from the parent plant at Beamsville as did that of Massey from Newcastle. Machines of both companies were breaking ground in the western plains before these were traversed by bands of steel, assisted the farmer in the cultivation of his land and in harvesting his crop, stimulated interest in settlement and provided two-way traffic for the fire-fed iron horse.

The activities of both Massey and Harris organizations were limited only by the frost-line and population factors. Competition failed to produce any further material advantage for the manufacturer or the farmer, whereas the principal features of their respective machines could be combined through amalgamation. Production costs could be lowered by the elimination of duplicate agencies in small towns, freight charges reduced through the shipment of car lots, and better service provided for the consumer. Factory specialization was introduced, and in 1892 a substantial cut was authorized in the price of many machines, this concrete result of the merger being welcomed throughout the country.

The Massey Company had transferred its entire plant in 1879 to Toronto, where head-quarters of the Massey-Harris Co., Ltd., were now established. Further strength was developed and greater service to the agricultural community of the

Right:—Modern harvesting methods are brought to the small farm by the little combine, which cuts a six-foot swath and threshes grain ready for bagging.

M
H
M
H



Modern methods of clearing bush lands. Tractor and sturdy plough (above) open new timber tracts for agricultural production. Brush-cutter attachment (below) fells small trees rapidly and economically.

Dominion made possible by the absorption of co-related concerns producing a wide range of equipment. Among the earliest manufacturers of farm implements in Canada was the firm of Patterson Brothers & Co., Ltd., which in 1850 founded the village of Patterson, and pioneered in the production of haying and harvesting machinery, and other equipment.

Five years after moving in 1886 to Woodstock, Ontario, whence a full range of tillage, cultivating, seeding and harvesting implements were distributed, the Patterson business was merged with that of J. O. Wisner Son & Company, whose history can be traced back to 1857. Fanning mills were fabricated in Brantford, and in 1871 production began of grain-drills, broadcast seeders, spring-tooth harrows, sulky rakes and hay-tedders. Shortly after the amalgamation of these two firms, the unit was purchased by the Massey-Harris Company as a going concern.

Another firm whose creation dates from 1857 was that of W. H. Verity & Sons, which manufactured ploughs in the little town of Exeter, Ontario, and eventually became known as the Verity Plow Company, Limited, until its affiliation with the Toronto organization. Farm waggons entered the catalogue in 1895, when the Bain Waggon Company, Limited, of Brantford, was absorbed, and its pages were extended in 1893, when the Corbin Disc Harrow business, of Prescott, Ontario, was acquired, and again in 1904 through the purchase of the Kemp Manure Spreader Company, of Stratford, Ontario. Production of bicycles was even undertaken in 1895, when all the world and his wife were seen on "wheels", but this branch of the business was sold to another firm, which still continues the manufacture of the "Massey" bicycle.

Plants Purchased in U.S.A.

Interesting developments occurred in the United States, where an enlarged market was sought, and the Johnston Harvester Company brought the Massey-Harris Company to Batavia, N.Y., in 1910, when it secured control of this firm, which dates back to 1871. Three years after this merger, when a demand developed for gasoline engines, the Deyo-Macey Engine plant, of Binghampton, N.Y., was purchased and transferred to Weston, Ontario, where engines ranging from two to fifteen horsepower for sawing wood, chopping feed, pumping water, etc., were produced. Agricultural tractors were manufactured at Weston in 1918, and the scope of the firm's activities in the power field was greatly extended ten years later by the acquisition at Racine, Wisconsin, of the J. I. Case Plow Works, Inc., which were equipped for the manufacture of tractors, tillage and other heavy implements.

Finally, to complete the wide circle of Massey-Harris influence, a factory was established in 1927 at Marquette, near Lille, France. The following year another was erected at Westhoven, Germany, and in 1930 an important merger was effected in Australia, where the Massey-Harris

STORY OF THE PLOUGHSHARE

Top: — Sand patterns in moulds await the pouring hours.

Centre: — Varnish dip administered as a rust preventive during storage.

Bottom: — Molten metal issues from cupola into bull ladel and thence to catching irons for pouring.

organization became associated with that of the largest Australian company of H. V. McKay, the trade name of which was altered to H. V. McKay Massey Harris Pty., Limited, which provides much of the agricultural machinery required in the Commonwealth.

Special conditions in the foreign field have necessitated the design or adaptation of machinery to meet local demands, for the Massey-Harris Company seeks to serve all manner of agricultural clients. Reaper-threshers, which cut and thresh grain in a single performance, are shipped to Africa, Argentina, the U.S.A. and other grain-growing countries. Trussers for tying straw in bundles as it comes from the thresher are supplied to the European trade. Ploughs specially suited to the soil of certain countries are produced, and one called a "stump-jump plough" has been designed for use in Australia. Various types of seed-drills are shipped to countries in which soil conditions, climate and even custom demand special characteristics. Rubber plantations in the Straits Settlements are furnished with a novel form of disc-harrow, while implements have been devised to be drawn by a yoke of oxen in Russia and South Africa, camels in Siberia, or of a very light character for the native trade.

World Ports Visualized

An air of romance pervades the shipping rooms, where names with which the average visitor is unfamiliar, except in so far as they appear as small points on his or her atlas, loom large on wooden packing cases. Thence the mind is transported to Table Mountain, towering above Cape Town; to the Sugar Loaf Mountain, presiding over the entrance to Rio de Janeiro; the Gateway of India, symbolized by a large archway on the water-front at Bombay; the beautiful Avenida de Mayo, in Buenos Aires; the terraced slopes of Valparaiso, surmounted by the majestic summits of the Chilean Cordillera; the modern docks at Mombasa, gateway to the high Kenya plains, across which stream countless herds of wild game; to Singapore and its hive of industry on the threshold of Near and Far East; to Sydney and its magnificent bridge, and maybe to the coral-skirted Islands of Bermuda, where some small implement will serve to produce a wealth of Easter Lilies. Thence went forth a Massey-Harris mower, which was eventually located near Altafjord, Norway, two hundred miles beyond the Arctic Circle. Canadians may visualize this machine cutting timothy in the same latitude as Aklavik, at the mouth of the Mackenzie River, and certainly far down north.

Through the establishment some twenty years ago of an Industrial Council, happy relations prevail between the management and employees. The council, comprising elected representatives of the employees and representatives appointed by the management, examines all matters pertaining to wages, hours of labour, employment and working conditions, safety measures for the prevention of accidents, sanitation and health in the plants. A further cause of general satisfaction is the pension scheme for which the company is entirely responsible. Of 204 pensioners on the list at present, thirty-five are over eighty years of age, and three of these have exceeded four score and ten.

Inspection of Modern Factory

Inspection of a modern implement factory reveals a happy relationship between industry and agriculture. Each experiences keen competition in its own field, the farmer requiring more efficient equipment in order to secure from his acres produce that can be sold in the domestic and foreign market on an economic basis, while the manufacturer demands craftsmanship and materials that will not be excelled by those of other lands in which a lower standard of living and wages prevails.

The average visitor cannot help but be impressed by the remarkable developments made possible through close co-operation established between the factory engineer and the farmer, whose problems he endeavours to solve through the design of special equipment. The contribution of this industry to the national economy must also arouse his admiration. Thirty-seven plants manufacturing farm implements in Canada during 1937 provided direct employment for an average of 6,446 persons, whose salaries and wages amounted to $7,350,043. Fuel and electricity, including 37,245 tons of coal and coke and 2,427,712 gallons of fuel oil, cost $567,240, and materials a total of $9,319,032.

These figures may be compared with those of 1920, when 99 plants employed 12,838 persons receiving $16,941,987 in salaries and wages. Materials cost $22,588,390. The gross selling value of products at the works amounted in that year to $50,301,302, as compared with

CANADIAN FARMING IMPLEMENTS

Above: Seed drill on Italian slopes.

Right: — Stripper harvester of 1905 vintage in Australia. This has been superseded by the modern combine.

Left:—Twin crank hayloader in Staffordshire, England.

Below: — Battery of six Canadian binders drawn by a steam tractor in Bohemia.

WELCOMED IN FOREIGN COUNTRIES

Above: — Camels provide traction for a mower in Siberia.

Left: — Mower near Altafjord, Norway, less than one hundred miles from the North Cape and well within the Arctic Circle.

Right: — One-way disc seeder lowers cultivation costs on an Argentine *estancia*.

Below: — Kaffir boy leads a span of oxen drawing a Canadian plough across the veldt in South Africa.

Left:—Blower of the thresher builds up mountains of straw, leaving the good grain behind.

$18,961,394 during 1937, which conveys some indication of the extent to which the industry suffered by reason of the depression, but in line to a material extent with that of the farmer.

The heaviest bill was for steel bars and rods, amounting in 1937 to 42,253 tons, having a value of $2,418,451. More than half-a-million dollars were paid out for pig iron and a similar amount for iron castings. Steel castings, forgings, plates, shafting, plain and galvanized sheets, strip, stampings, structural shapes and wire, alloy steel, scrap iron and steel of all kinds were also purchased, and these may be seen in various stages of development—from the molten metal streaming forth from a cupola, the assembly of numerous parts and their assumption as a complete machine of attractive colours that are also rust resistant, to the final process of crating in preparation for shipment to the four corners of the world.

Aluminum, brass and bronze castings, copper sheets and bars, lead, nickel, tin, zinc, babbitt and other metals enter the factory for conversion. Iron and steel pipe, tubing and fittings, bolts, nuts, rivets and screws, electrical equipment, including motors, paints, oils and varnishes, rubber and leather goods, wheels, cotton, duck and other textiles, foundry coke, moulding sands, plumbago, lumber, firebrick, fireclay, core compounds and shipping containers comprise additional supplies purchased by the industry, employment in the production of which is provided for men deep in the bowels of the earth, technicians, chemists and research physicists in many parts of the country. Railroads, steamship companies and truck operators derive considerable value from the transportation of materials to the factory and the completed product to its ultimate destination. The list might be extended almost indefinitely, as this is a truly great industry.

The Dominion Bureau of Statistics reports that farm implements and machinery were exported from Canada in 1937 to twenty-one major countries, the value of which amounted to $10,000,033, compared with a total of $6,068,155 the previous year. The United States proved to be the best market, accounting for approximately $3,456,000 of the total, with Argentina second, $2,453,000; British South Africa in third place, $1,312,000; and Great Britain fourth, $1,210,000. Other lands listed are Australia, Belgium, Chile, Denmark, Finland, France, French Africa, Germany, Irish Free State, Italy, Mexico, Morocco, New Zealand, Norway, Portuguese Africa, Sweden and Uruguay.

Agricultural operations are introduced to the younger generation who thrill to the throttle of a tractor drawing a tandem disc harrow.

Right:—Weeds are effectively eradicated in the wake of the harvest with a one-way disc harrow.

On the other hand, nine of these countries sold implements and agricultural machinery to Canada, of which the United States is credited with no less than $16,275,597. This figure may be compared with the gross selling value of products manufactured in Canada during 1937 of $18,961,394. Total imports amounted to $17,233,658 in value, Great Britain being in second place with a total of only $490,588.

Social System Surveyed

Whereas the introduction of machinery to agriculture has decreased the demand for casual and migrant labour, especially during the harvest period, it has had the effect of populating waste areas. There are large tracts of land in Canada, the United States, Argentina, Australia and other countries that can be farmed only through the employment of modern machinery, the alternative being to utilize them for raising stock or in the production of timber. Mechanization requires skilled workers, and these receive a higher wage, made possible with the operation of a more efficient production unit. The alternative, again, is a continuation of primitive methods that demand the retention of peasant holdings. The social system has changed in the western world, agriculture being provided with the means whereby the cost of production may be lowered, while a large army of industrial workers derive material advantages from the manufacture of equipment in ever larger quantities.

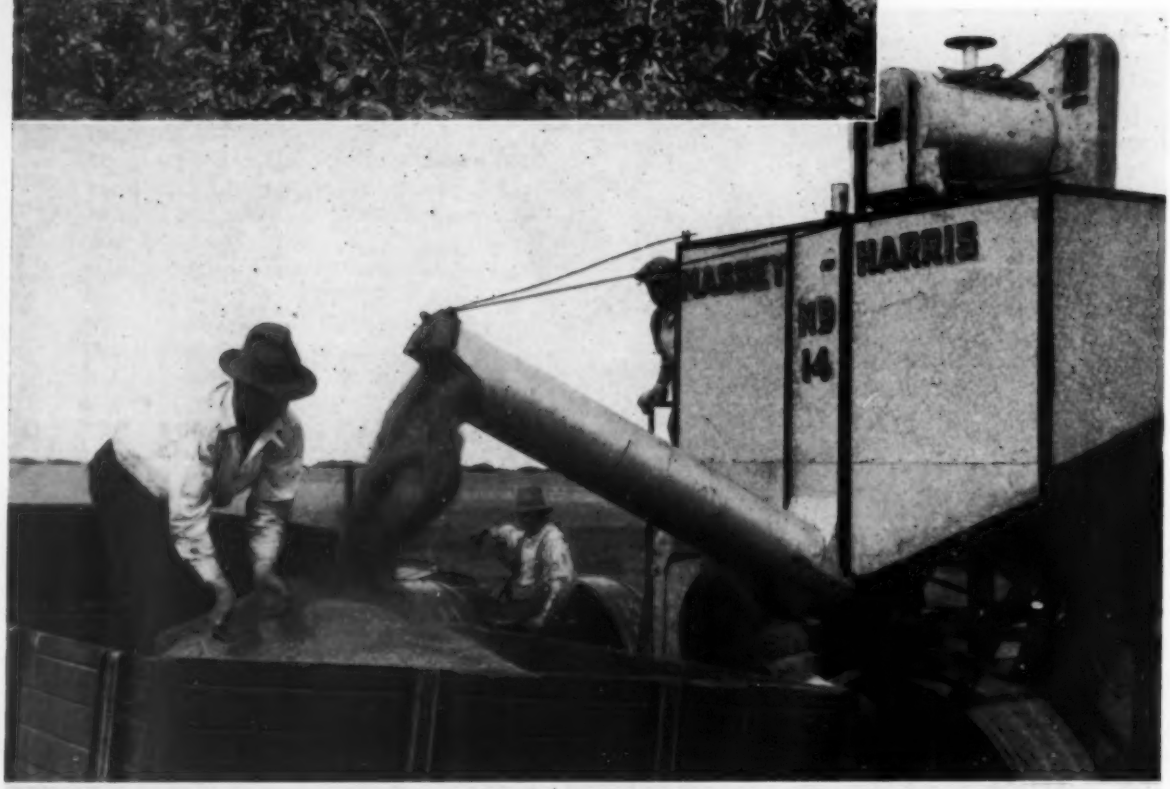
Canadians who are ever conscious of their position within the British Commonwealth may well reflect for a moment, in conclusion, and consider whether this country is better qualified to "Build Bombers for Britain" or to "Become the Bread Basket for Britons". She can do both, of course, but bread is more important than are bombers during the days of peace and equally as important during the days of conflict. Wheat production is strictly limited within the United Kingdom, which must depend for her supplies on some other country, such as Canada, the sea route to whose ports is less vulnerable than that of any other nation within the British Commonwealth. Manufacturers of farm implements and those supplying materials for their fabrication can claim, with those engaged directly in agriculture, that their contribution towards the preservation of peace is no less than the efforts being put forward by armament manufacturers in providing the means for protection from some revolutionary or belligerent outbreak.

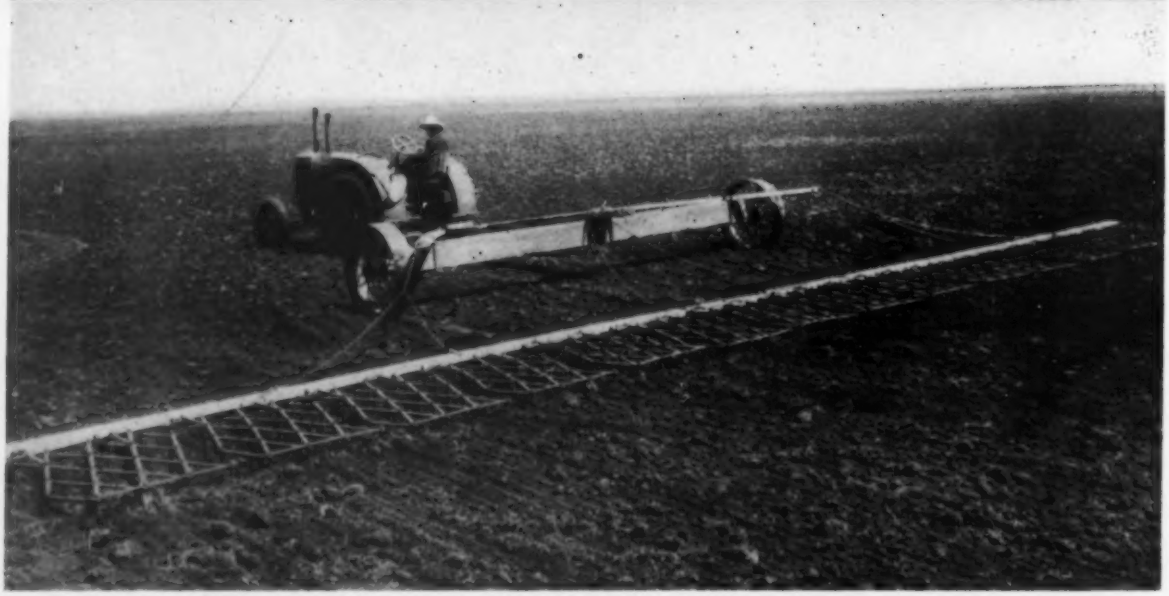
"The harvest truly is plenteous, but the labourers are few."

Top: — "Row crop" tractor engaged in cultivation of large beet acreage. Wheels may be moved on axles to suit various spaces between rows.

Centre: — Threshed grain streams from a large combine to a waggon box.

Bottom: — Man's ingenuity meets the problem of vast areas with this spike-tooth drag harrow and other such implements of large capacity.

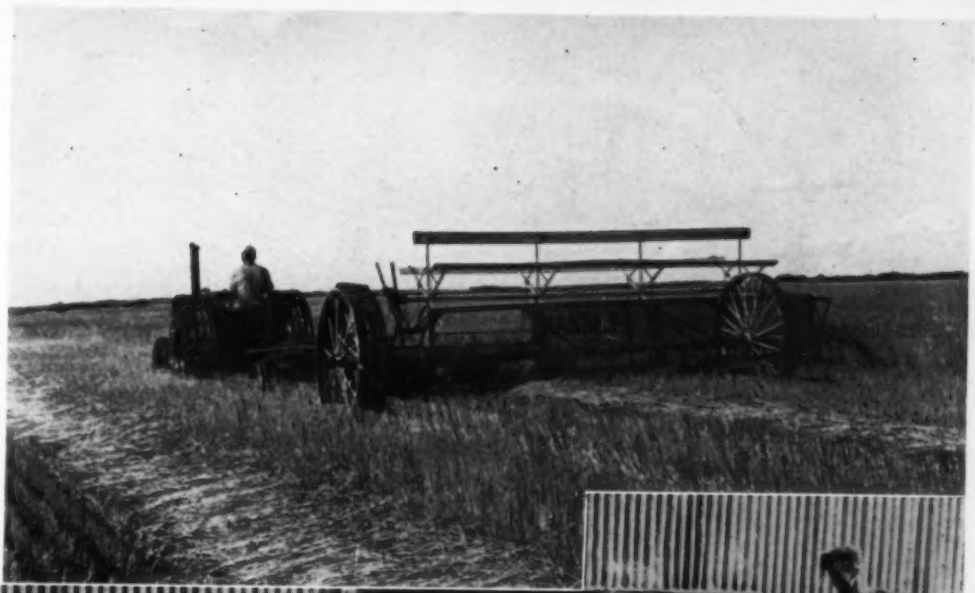


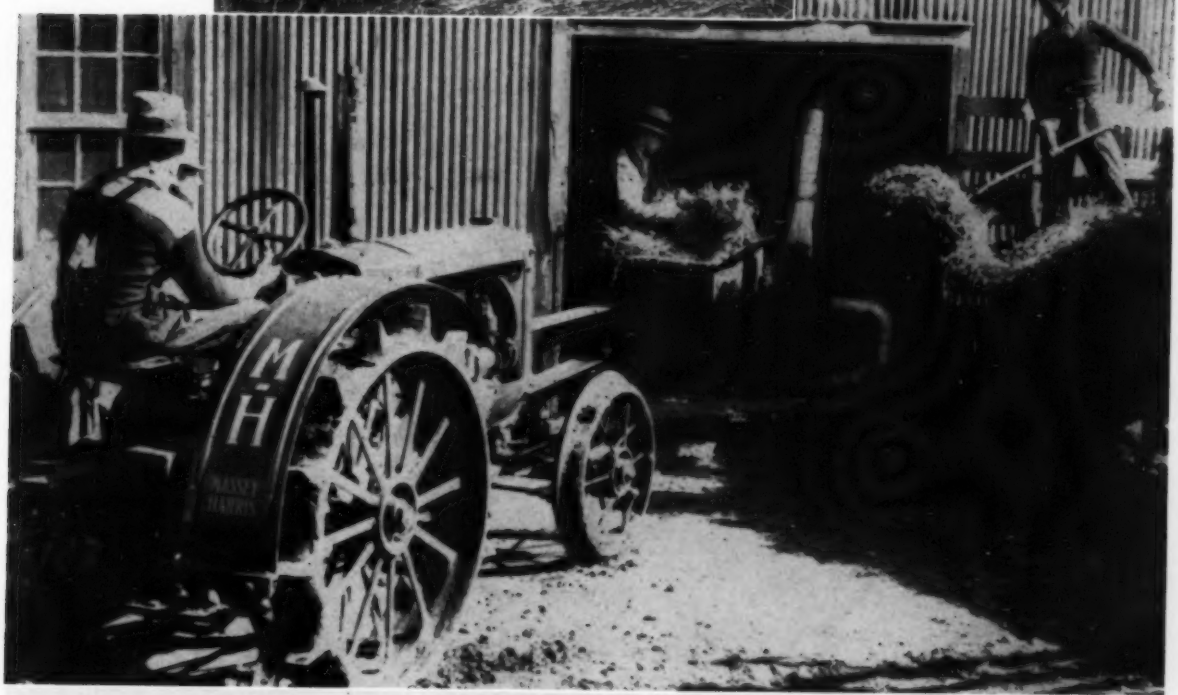


Top: — Where grain does not ripen evenly, the swather cuts and leaves it on the stubble, later to be threshed by combine.

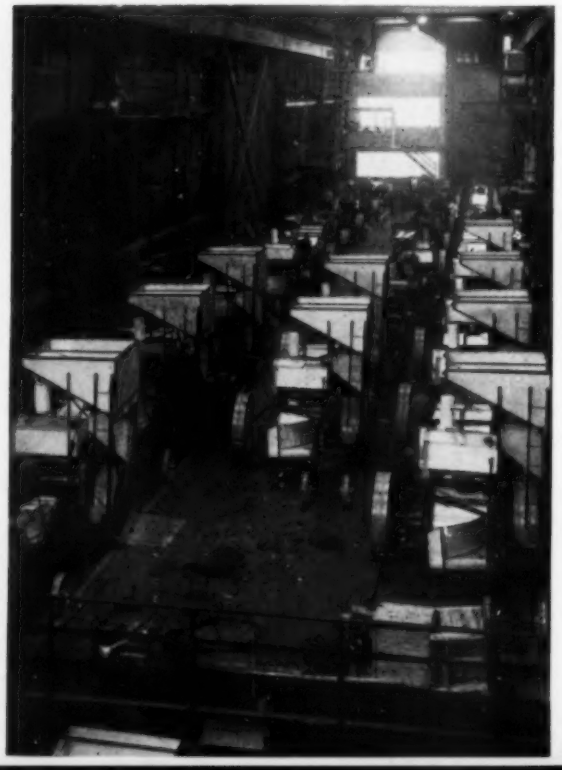
Centre: — Feed prepared in a hammer mill, operated by belt power from a tractor.

Bottom: — Threshing from the stook, the final field operation in garnering the harvest.



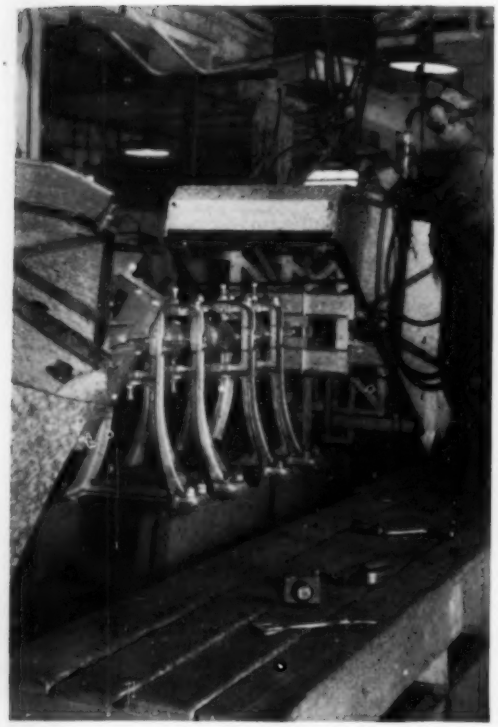


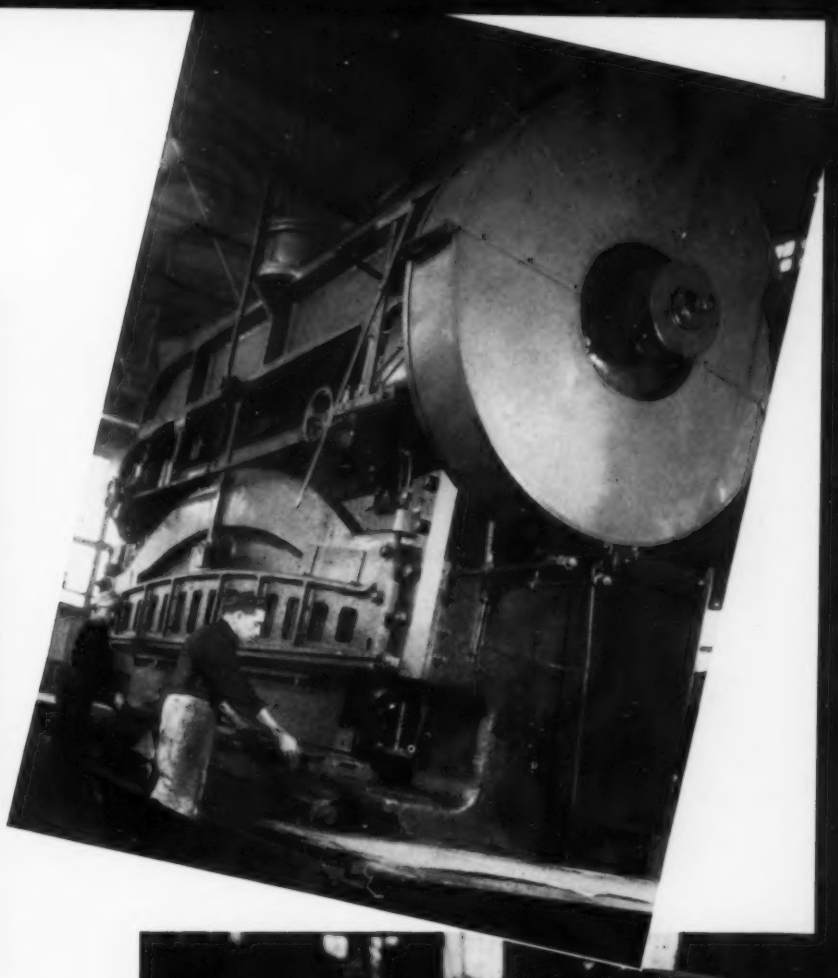
MECHANICAL EQUIPMENT



Above:—Electric welding on assembly line. Left top:—Sand moulds for mower gear boxes. Left centre:—Polishing ploughshare. Left bottom:—Boring and reaming machine. Below:—Combine assembly line at point of rail shipment.

FACILITATES FABRICATION





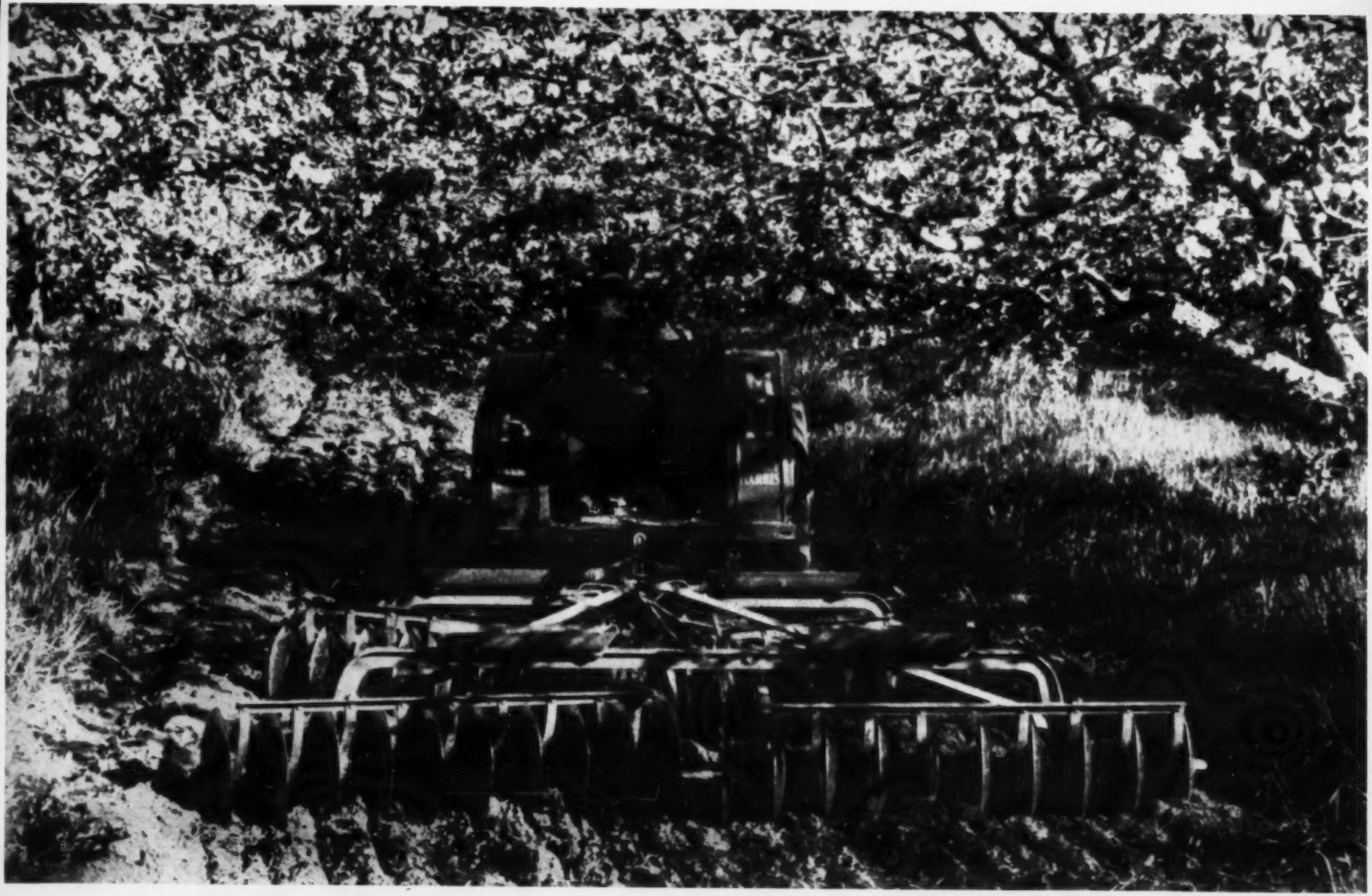
Right top:—Powerful press reduces manufacturing costs. Right centre: — Twelve operations performed by one machine on a binder arm. Right bottom:—Foundry during the pouring process. Below: — Tool and die maker; the man behind the man at the machine.

Machinery combines the operations of sowing, fertilizing and planting potatoes, curtailing the methods of former times. The capacity of this planter is eight acres a day.

Right—Fabricated steel — bars and rods, castings, forgings, plates, shafting, sheets, strip, stamping, structural shapes, wire, etc. — presents the Canadian implement manufacturers with their largest bill for materials. This amounted in 1937 to nearly $4,000,000 for 74,500 tons.

Large acreages of grain are harvested with the power-take-off binder, driven directly from the tractor.

Large acreages of grain are harvested with the power-take-off binder, driven directly from the tractor.



Blossom time in the Annapolis Valley, Nova Scotia, finds the apple grower ploughing, cultivating and harrowing his orchard with tandem disc equipment.

Typical Western Wheat Field during a favourable year.

New Wheat Creations And Their Significance To Canada

by **L. H. NEWMAN**

THE rise to prominence of Canada as one of the world's great producers of spring wheat is due in no small measure to the success which has rewarded the efforts of her plant breeders in developing varieties capable of meeting successfully the challenge of Nature. Indeed, it is freely admitted that in no country has the work of the scientific breeder of plants contributed more directly and substantially to national prosperity than it has in Canada. Working with infinite patience yet with grim determination, he has created varieties which have turned what was once considered a distinctly hazardous occupation over wide areas into a relatively safe enterprise and thereby has added millions of dollars annually to the value of Canadian production.

The history of the leading wheat varieties grown in Western Canada to-day is truly an epic in the realm of scientific achievement. It reveals a story of determined effort, extending over more than half a century, replete with discouragements and disappointments, but ultimately rewarded with enormous gains. It epitomizes the history of wheat breeding in Canada during the past 50 years and compels our appreciation particularly, of the man who initiated this work which has meant so much to Canada. To this man, the late Dr. Wm. Saunders, first Director of the Dominion Experimental Farms, and father of the late Sir Charles Saunders, first Dominion Cerealist, Canada owes a debt, the magnitude of which is beyond all human calculation.

When William Saunders took over his duties as Director of the newly established Dominion Experimental Farms System, in 1886, and set up his office at the Central Experimental Farm at Ottawa, he very quickly decided that if the great virgin areas of the West, then opening up to civilized settlement, were ever to attain a place of any great importance as a wheat-growing section, it was absolutely imperative that earlier varieties than old Red Fife, the variety then commonly grown, be used. In fact, he considered that the securing of such a wheat was his most important job at that time. And thus begins the alluring story of the long years of patient work so well started by Director

Corner of breeding block. Cereal Division Head-quarters, Experimental Farm, Ottawa, the birthplace of Marquis, Ruby, Reward, Garnet and numerous new promising hybrids. (Inset) Plant breeder at work.

Saunders and so ardently followed by his successors in this field.

In his quest for an early ripening wheat, Dr. Saunders naturally explored those countries which by reason of their altitude or latitude, were compelled to grow early varieties. Accordingly such countries as Russia and the elevated sections of India received special attention, and from these old civilizations some most interesting types were obtained. But none of these was good enough. It is true some were sufficiently early but they lacked either in productivity or in quality or both. It finally was decided that the greatest hope lay in the actual creating of what was needed by cross-breeding. If Nature did not offer a variety combining the attributes of the wheat wanted, man himself must "step in with impious hands and bend her mysterious workings to his will."

The first crosses were made at Ottawa on July 19, 1888, between the early Russian variety, Ladoga, and the high quality but late maturing Red Fife. Since that time, many hundreds of new wheats have been created and out of all this material have emerged the wheats which have played so large a part in placing Canada in the enviable position she holds to-day. To the old-time westerner, such varieties as Preston, Marquis, Prelude, Ruby, Reward and Garnet are household words. These wheats, all definitely earlier than Red Fife, have made it possible not only to grow wheat further north than would have been possible with Red Fife, but what is of greater importance, they have rendered the business of wheat growing much less hazardous in the older sections of the West

The Challenge of Rust

While the gradual rise of the wheat growing industry of Western Canada to its present status has been made possible very largely by the introduction of earlier maturing varieties, the maintaining of that position is going to depend on varieties which not only ripen relatively early but which also are capable of withstanding disease. For Nature has launched a new challenge and the dominion of man over his present wheat-lands is threatened by another enemy. And this enemy is *Rust*.

Rust, according to plant pathologists, is caused by an organism belonging to a low order of plant life, the fungi It shows itself first in the form of elongated, reddish-brown pustules, which appear on the stems and leaves of the wheat plant usually in late June or early July. Each of these pustules contains a vast number of spores, which are carried by the wind to other plants to spread the disease. Under favourable conditions of temperature and moisture, the spores germinate and send out thread-like "germ-tubes" which penetrate between the cells of the green tissue to produce new pustules in about 8 to 10 days' time. Each spore, therefore, is

Late maturing Red Fife (on left); earlier maturing variety, Marquis (on right).

capable of enormously reproducing itself within a little more than a week, which accounts for the remarkable rapidity with which rust epidemics usually spread.

The damage suffered by the crop is due almost entirely to the parasitic nature of the disease, the plant food being utilized by the fungus rather than by the plant. As a result, the grain simply shrinks and withers until very frequently there is little left worth the expense of harvesting.

One of the first serious visitations of wheat stem rust in Western Canada took place in 1904, since which time there have been several disastrous attacks. One of the worst of these took place in 1916, a war year of high prices, when the losses were calculated at approximately $100,000,000.

In 1923, 1927, 1930, 1935 and 1938, very heavy losses again were experienced, but possibly the worst epidemic suffered by the West, from a national standpoint, was that of 1935, when the wheat crop was so badly damaged that thousands of acres were never harvested but were burned or ploughed under. During that tragic year, it was estimated that approximately 85,000,000 bushels less wheat were harvested than would have been harvested had there been no rust. This loss in bushels, added to the loss in grade of the wheat harvested, brought the total loss for the year to an astounding figure.

The situation in 1935 was particularly disappointing and disheartening in view of the fact that at long last, after several lean years due to drought, the people both on the farms and in the cities had been looking forward to what promised to be a bumper harvest, only to have their hopes dashed to the ground by the sudden appearance, during the latter part of June, of the forerunners of what they knew only too well to be another onslaught of their old arch enemy — rust. To many, the epidemic which followed was almost the last straw. They knew they could not expect much in dry years, so had waited with confidence for a year like 1935 when moisture would be plentiful, forgetting perhaps that such a year is likely to provide the very conditions required for the spread of the rust fungus. But the season of 1935 with its tragic disappointments and heartaches was destined to go down in history for quite another reason. By strange coincidence, this year of grace not only was to witness one of the worst rust epidemics in our history but it was to prove, to the satisfaction of even the most skeptical, that new and effective weapons forged by man were soon to be available for the Rust King's undoing. For at the different experimental farms and universities throughout the West were to be seen under test, a number of brand new wheats proudly demonstrating their mysterious power to *resist all attacks* of the enemy. Standing fresh and green and unaffected, with healthy heads, filling with plump rich grain, they presented a thrilling spectacle in contrast to the picture of destruction and desolation everywhere about. But thereby hangs a tale, a tale of an organized battle against this dread spectre, starting almost 20 years before and now culminating in one of the greatest victories of all times. The story, like the story of all great achievements, is full of human interest.

The preliminary skirmishes took place following the calamitous epidemic of 1916 when thousands of farmers were almost ruined. A great national calamity had taken place and people in the cities as well as on the farms had suffered. Business in the East as well as in the West, had

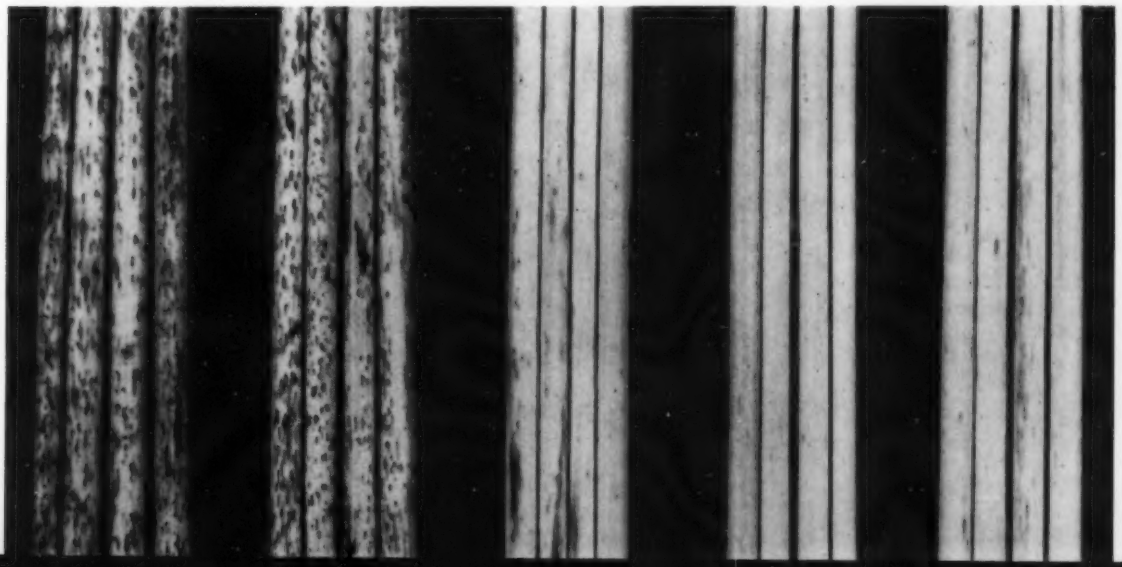
received a severe body blow. The problem was a national one and our National Government decided that it must act. Accordingly it called its scientific forces together at Winnipeg, in August, 1917, and explored every conceivable means whereby a repetition of the disaster might be averted. Experts from the Dominion and the Provincial Departments of Agriculture and from the universities largely composed the conference and devoted three intense days to earnest deliberation. A more definite and aggressive programme than any previously followed was needed. While various experts had been working on the problem, their methods or technique had not proved adequate. The key to the situation finally was suggested by the late Dr. Charles Saunders, then Dominion Cerealist, who expressed the opinion that if the plant breeders and the plant pathologists were to work together more closely, greater hopes might be entertained for ultimate success. This suggestion became the guiding principle of the conference and of the general programme adopted at that time and in operation ever since.

One of the important accomplishments of the 1917 conference was the decision to establish at one or more of the Western Agricultural Colleges a plant pathological laboratory with a well qualified pathologist in charge in order to carry on investigational work associated with the rust problem. It was agreed that the Dominion Department of Agriculture should assume the leadership and provide the personnel and equipment. A general committee representing the various institutions involved was set up for the purpose of co-ordinating plans and making such recommendations as might seem desirable from time to time.

While this conference marked the beginning of the co-operative method of attack, it gradually became apparent as years passed, that a greatly enlarged programme of breeding work and pathological investigation must be adopted before any worth-while progress could be expected. Finally, in September, 1924, the Dominion Minister of Agriculture, the Honourable W. R. Motherwell, and Dr. H. M. Tory, President of the National Research Council, joined forces in calling a second conference at Winnipeg composed of the original committee, along with others directly or indirectly concerned. This group aggressively grappled with the situation and laid out a programme of procedure, the character and scope of which have been the subject of world-wide acclaim. Fortunately for Canada, the Dominion Government of the day was entirely sympathetic and readily granted the necessary financial support to carry the new programme into effect.

It was agreed that there should be established a "Dominion Rust Research Laboratory" and field nursery somewhere within the rust area of the West where a concentrated effort would be made to create new varieties of wheat capable of resisting attacks of even the most severe epidemics. This undertaking, it was recognized, would involve the consideration of the pathologist as well as the plant breeder. Rust is a complex disease, embracing many different biological forms or races, the more virulent of which must be maintained in pure condition for use in artificial inoculations to prove the resistance of new productions. This and many other angles of the problem naturally must be the concern of the pathologist. The Manitoba Agricultural College offered to provide the necessary land for the

Stems of Susceptible Varieties of Wheat covered with rust pustules (on left) Rust Resistant Varieties (on right).



The Dominion Rust Laboratory, Winnipeg, Manitoba, birthplace of the rust resistant wheat varieties, Renown and Regent.

Corner of plant breeding trial grounds, Dominion Rust Research Laboratory, Winnipeg, Manitoba.

By making it possible to produce two or even three crops a year, greenhouses greatly expedite the task of developing new varieties.

Test plots at an Experimental Farm. All new varieties of wheat of promise are tested for yield and other agronomic characteristics at Dominion Experimental Farms as well as at Provincial Institutions.

undertaking and to furnish heat, light and water for such buildings as might be erected. This offer was gladly accepted and in due course, a building — the now famous "Rust Research Laboratory" — was erected, equipped and manned by the Dominion Government. The laboratory quickly became the centre of rust research activities — the army head-quarters — for Western Canada, and has maintained that position to date, although certain affiliated institutions, notably the Dominion Experimental Farm, Brandon, and the University of Saskatchewan at Saskatoon, have done some excellent work, more or less independently, and have made some valuable contributions.

The personnel at the Winnipeg Laboratory is divided into two main groups. One group consists of officials of the Cereal Division, Dominion Department of Agriculture, while the other is composed of officers belonging to the Division of Botany, now a Division of the new "Science Services Branch" of the same Department.

The Cereal Division group, under the *direct* leadership of Dr. C. H. Goulden, has been largely responsible for the creation of the new rust resistant wheats produced at the Laboratory although the officials of the Division of Botany have had charge of all the pathological phases of the undertaking. The latter group was directed at the outset by Dr. D. L. Bailey, who later resigned to accept a position at the University of Toronto. He was succeeded by Dr. J. R. Craigie, last year's winner of the prize offered by the Professional Institute of Canada for the most outstanding scientific achievement of the year.

With men of the training and calibre of Goulden and Craigie as leaders in their respective fields, supported as they have been by a brilliant and aggressive staff, it is not surprising that the forces of Nature were bent back and finally put to rout. For these men raided the innermost secrets of Nature and stole her most powerful weapons.

Associated closely with the Rust Laboratory experts, but carrying on his work at the University of Saskatoon to which institution he is attached officially, Dr. J. B. Harrington has succeeded in producing some notable new rust resistant wheats, one of which called Apex, compares favourably with the best Rust Laboratory productions.

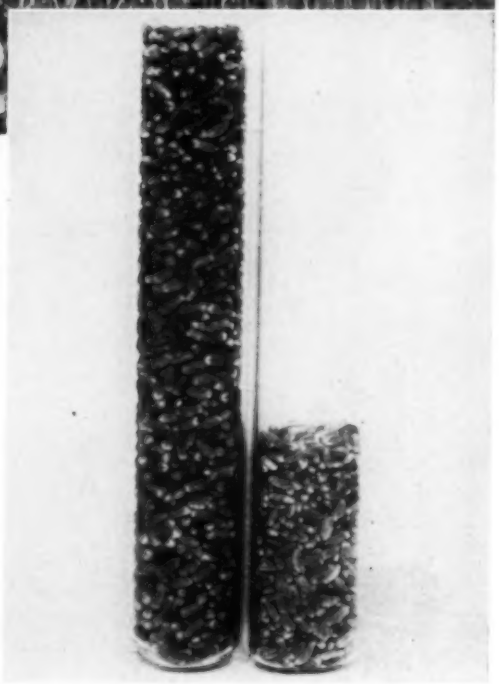
The Origin of our Leading Rust Wheats

Twenty years ago, there was no bread wheat known which was able to resist rust For many years, however, it was known that certain of the so-called tetraploid wheats, the durums and the emmers, carried a high degree of rust resistance, but it was not until 1920, that a successful cross between a durum variety (Iumillo) and a common wheat (Marquis) made by Hayes, Parker and Kurtzwell, was reported. The only named variety emerging from this cross was called Marquillo but this variety while quite resistant was not a commercial success. It lacked quality. It was used, however, by Hayes and his co-workers in their breeding work and became one of the parents of the excellent variety, Thatcher, which has proved so valuable both in Canada and in the United States.

Following the establishment of the Rust Laboratory, Goulden succeeded in 1925, in making crosses between the highly resistant durum variety, Pentad, and the common variety, Marquis. From the resulting material, a number of very productive and highly resistant bread types were obtained but none of these has been good enough to warrant distribution for propagation in the West as yet.

In 1916, E. S. McFadden, a noted American plant breeder working in South Dakota, succeeded in producing fertile hybrids from crosses between the highly resistant emmer variety called Yaroslav (C.I. 1526) and the Canadian common wheat, Marquis. Two of these hybrids, Hope and H-44, were true bread wheats and were highly resistant to rust but were not quite good enough for distribution. They have proved exceedingly valuable, however, in breeding work and have been used very extensively on both sides of the border. As a matter of fact, the leading wheats developed by the Rust Laboratory to date, including Renown, carry the "blood" of one or the other of these two epoch-making productions. Renown originated from a cross between H-44 and Reward, as did several other varieties now undergoing their final tests. Apex developed by Harrington at Saskatoon, combines H-44 with Marquis, Kanred and Iumillo.

In order to ensure and promote co-operative action, various Associate Committees were set up at an early date under the National Research Council and the Dominion Department of Agriculture,

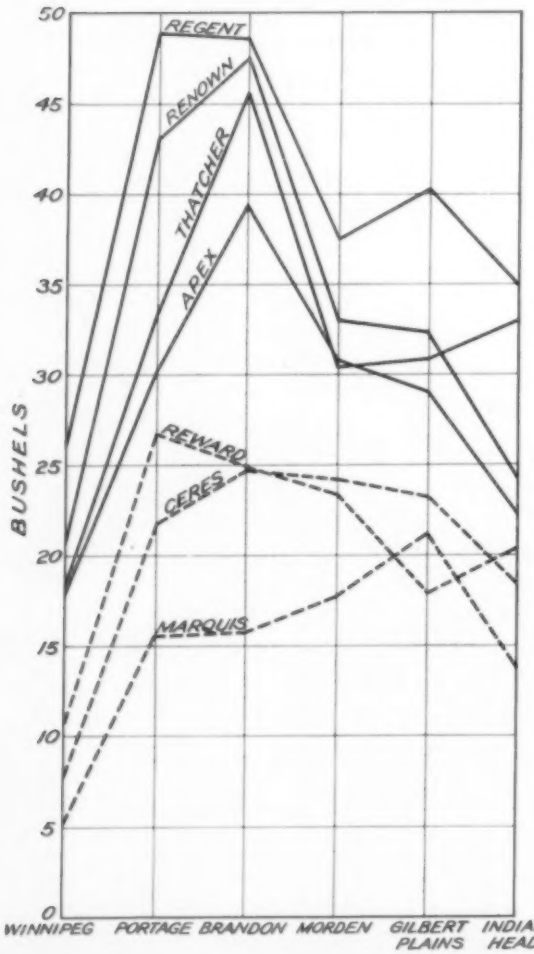


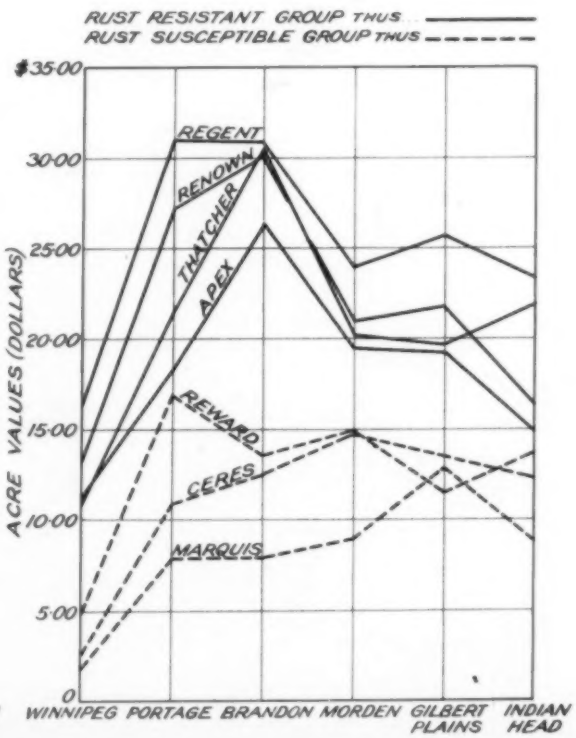
Above: Common Variety (on left) badly lodged as a result of rust; Renown (on right) is undamaged by this disease.

Right:—Relative Yields and Development of grain of Renown (left) and Marquis (right) grown at the Dominion Experimental Farm, Brandon, 1938. Note effect of rust on Marquis.

Bottom Left:—Yields per acre obtained in 1938 at six representative points of four rust resistant varieties and three rust susceptible varieties of wheat

Bottom Right:—Computed market value *per acre* of wheat produced from each of seven different varieties grown in plots at six representative points in 1938. The values have been determined by multiplying the actual yields by the Wheat Board price paid in Central Manitoba for the grade awarded each variety.





and facilities were provided whereby they would be able to meet at least once a year and study the results obtained. This has proved an exceedingly valuable arrangement as it makes all interested institutions and individuals parties to whatever decisions may be reached. Thus all new varieties which seek recognition must be approved by the Associate Committee on Field Crop Diseases and by the Associate Committee on Grain Research before they can be recommended for licence. This situation automatically brought about the adoption of a plan of conducting co-operative field tests each year of the most promising new varieties, along with the leading standard varieties, at practically all experimental farms and universities in Western Canada as well as on a number of selected farms. It also caused to be initiated certain arrangements whereby the relative baking qualities of the new wheats might be investigated co-operatively. This was accomplished through the Associate Committee on Grain Research, on which Committee the laboratories of the Cereal Division, Ottawa, the Grain Research Department, Board of Grain Commissioners, Winnipeg, and the Universities of Saskatchewan and Alberta are represented. Valuable assistance is also given by chemists connected with various experimental and commercial milling concerns both in Canada and in other countries.

The reputation of Canadian wheat has been built up on *quality* and this must be maintained at all costs. In order to ensure this, the Canada Grain Act demands that all varieties admitted into the top four grades must be of a quality at least equal to that of Marquis. In other words, Marquis has been accepted as the standard of quality and all new varieties bidding for a place must measure up to the high standard of this fine old variety. This requirement naturally has caused many otherwise excellent varieties to be thrown into the discard but it has preserved for us the high reputation of our wheat on the world's markets. In the practical application of this important provision of the Grain Act, the Board of Grain Commissioners by whom it is administered, depends very largely upon the Grain Research Committee for advice and guidance.

As a result of all these efforts, centralized as they have been around a common problem and co-operatively handled in the most approved fashion, the long-looked-for day has come when rust resistant varieties of wheat of approved baking quality and of excellent yielding ability are now available for commercial propagation.

Renown, the first Rust Laboratory variety to be introduced, was released for trial by farmers in Manitoba and Eastern Saskatchewan in the spring of 1937. From this initial distribution, it is estimated that there will be approximately 1½ million bushels available for seeding in the spring of 1939.

Apex, the first rust resistant variety produced by the University of Saskatchewan was also released in the spring of 1937 and has increased until approximately 20,000 bushels are now available. This variety has done well in Saskatchewan and Alberta tests particularly.

Thatcher, although developed outside of Canada, has been in the Canadian tests for a number of years and is highly regarded both on account of its yielding ability and its baking qualities. A licence was granted for the sale of Thatcher in Canada in the autumn of 1935, and about 24,000 bushels of this variety were sown in Manitoba and Saskatchewan the following spring. From this initial seeding, it is estimated that between 50 and 60 million bushels were harvested in 1938. Unfortunately, Thatcher, while resistant to stem rust, is highly susceptible to leaf rust and may suffer serious damage both in quality and yield when this disease is severe, as it was in Manitoba particularly, in 1938. In spite of this handicap, Thatcher proved infinitely superior to the old standard varieties, Marquis, Ceres and Reward, in Manitoba and Eastern Saskatchewan where stem rust was once again present in epidemic proportions. To this variety, in spite of its shortcomings, many hundreds of growers, even in the leaf rust areas, will always be indebted.

The latest variety to pass all requirements and to be approved for licence and for inclusion in the northern grades has been named *Regent*. This variety, known formerly as number R.L.975.1, has not only passed all tests imposed upon it in Canada, but it has successfully met the exacting requirements of commercial milling and baking tests conducted in England during the past winter. Like Renown, this variety originated from a cross between H-44 and Reward made at the Dominion Rust Research Laboratory under Dr. Goulden. It is being made available for trial by western farmers for the first time this coming spring and it is hoped that it may prove of special value in many districts.

To those who have been following closely the trend of events, the significance of these new wheat creations to Canada will be fully appreciated. To them, the year which has just passed will always stand out as an historic one — the first year that Western Canada has been spared a major catastrophe on account of rust. Although rust was present last year in epidemic proportions, the fact that over three and one half million acres were occupied by rust resistant wheats in Manitoba and Eastern Saskatchewan minimized enormously the damage which otherwise would have been wrought. Indeed, careful calculations have shown that the savings effected by these epoch-making creations amounted to probably not less than thirty million dollars. But that is not all. What is even more gratifying and significant is the knowledge that in 1939 and in each succeeding year, there will be seed of these new types for every producer of spring wheat in Canada; and thus what has been one of the greatest of all crop hazards will have passed into history.

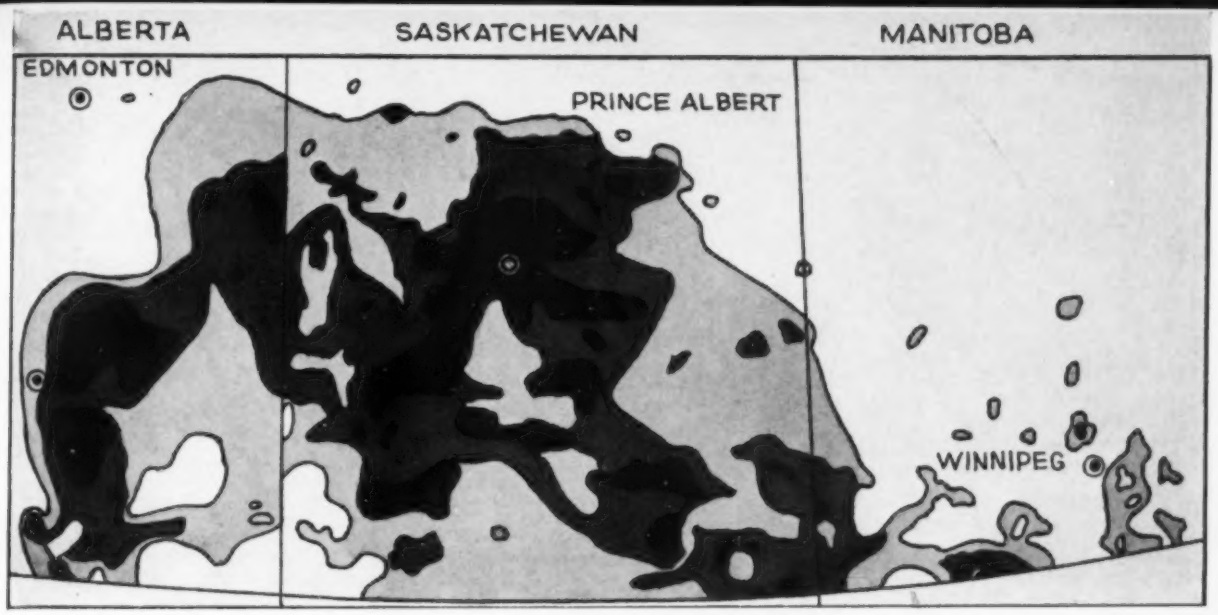
As we now reach the climax of the story, the question which many will ask is: "What of the future? Have we reached the end of the road?" While the main battle undoubtedly has been won, a review of the present situation indicates clearly that important advances are still possible. Thus we need wheat varieties which combine early maturity with rust resistance, high quality and satisfactory yielding ability. We need types which are both rust-resistant and drought-resistant, since years of low moisture supply may be expected even in those areas which normally are subject to rust. And finally we need varieties which will combine with other desirable characteristics the ability to withstand insect attacks. In this connection it is heartening to know that many new types now under investigation appear most promising.

RELATIVE VALUES OF SEVEN WHEAT VARIETIES in 1938

Variety	Where Grown	Yield per Acre	Commercial Grade	Street Price per bus. at Portage	Gross Value per Acre
		(Bus.)			
Regent	Winnipeg	25.9	2	.63½	16.45
	Portage la Prairie	48.9	2	.63½	31.04
	Brandon	48.6	2	.63½	30.86
	Morden	37.5	2	.63½	23.81
	Gilbert Plains	40.2	2	.63½	25.52
	Indian Head	34.9	1	.66½	23.20
Averages		39.3			24.90
Renown	Winnipeg	20.2	1	.66½	13.43
	Portage	42.9	2	.63½	27.24
	Brandon	47.5	2	.63½	30.16
	Morden	33.0	2	.63½	20.95
	Gilbert Plains	32.4	1	.66½	21.54
	Indian Head	24.3	1H	.67½	16.40
Averages		33.4			21.62
Thatcher	Winnipeg	18.1	3	.60½	10.95
	Portage	33.4	2	.63½	21.21
	Brandon	45.7	1	.66½	30.39
	Morden	30.4	1	.66½	20.20
	Gilbert Plains	30.8	2	.63½	19.58
	Indian Head	33.0	1	.66½	21.94
Averages		31.9			20.66
Apex	Winnipeg	17.7	2	.63½	11.20
	Portage	30.0	3	.60½	18.15
	Brandon	39.4	1	.66½	26.20
	Morden	30.6	2	.63½	19.43
	Gilbert Plains	29.0	1	.66½	19.28
	Indian Head	22.2	1	.66½	14.76
Averages		28.1			18.17
Reward	Winnipeg	10.4	5 spec.	.43½	4.52
	Portage	26.6	2	.63½	16.89
	Brandon	24.8	4	.54½	13.51
	Morden	23.4	2	.63½	14.85
	Gilbert Plains	17.9	2	.63½	11.36
	Indian Head	20.4	1	.66½	13.56
Averages		20.6			12.45
Ceres	Winnipeg	7.5	Feed	.33½	2.51
	Portage	21.7	4 sp.	.50½	10.95
	Brandon	24.7	4	.54½	12.46
	Morden	24.3	3	.60½	14.70
	Gilbert Plains	22.2	3	.60½	13.43
	Indian Head	18.4	1	.66½	12.24
Averages		16.6			11.05
Marquis	Winnipeg	5.0	Feed	.33½	1.67
	Portage	15.5	4 sp.	.50½	7.83
	Brandon	15.6	4 sp.	.50½	7.88
	Morden	17.6	4 sp.	.50½	8.88
	Gilbert Plains	21.2	3	.60½	12.83
	Indian Head	13.7	2	.63½	8.70
Averages		14.8			7.96

The experimental milling laboratory at the headquarters of the Cereal Division, Ottawa, where samples of all new wheats are milled into flour for the evaluation of their milling and baking qualities.

The baking laboratory of the Cereal Division, Ottawa. All new varities of wheat must be at least equal in quality to the standard variety, Marquis, before they will be accepted in any of the four highest grades. The testing of new varieties for milling and baking qualities is one of the important features of the whole undertaking of wheat improvement.



Sketch map of forecast of grasshopper outbreak in 1939. Black areas represent combined "severe" and "very severe" infestation; dark grey areas represent "moderate or threatening" infestation and light grey represents areas of "light and patchy" infestation.

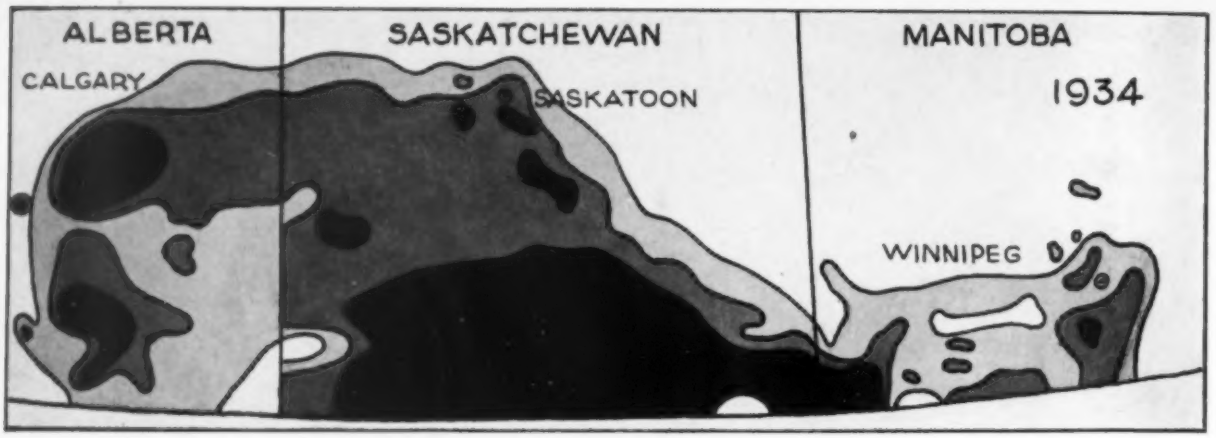
INSECTS AS A FACTOR IN WHEAT PRODUCTION ON THE CANADIAN PRAIRIES

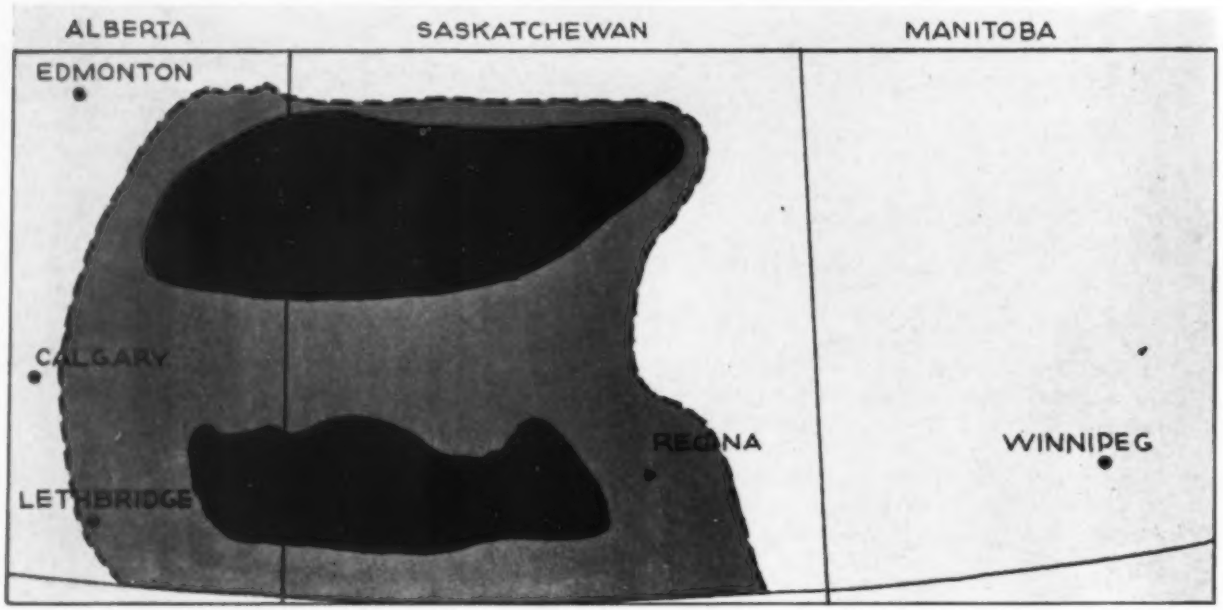
by **H. G. CRAWFORD**

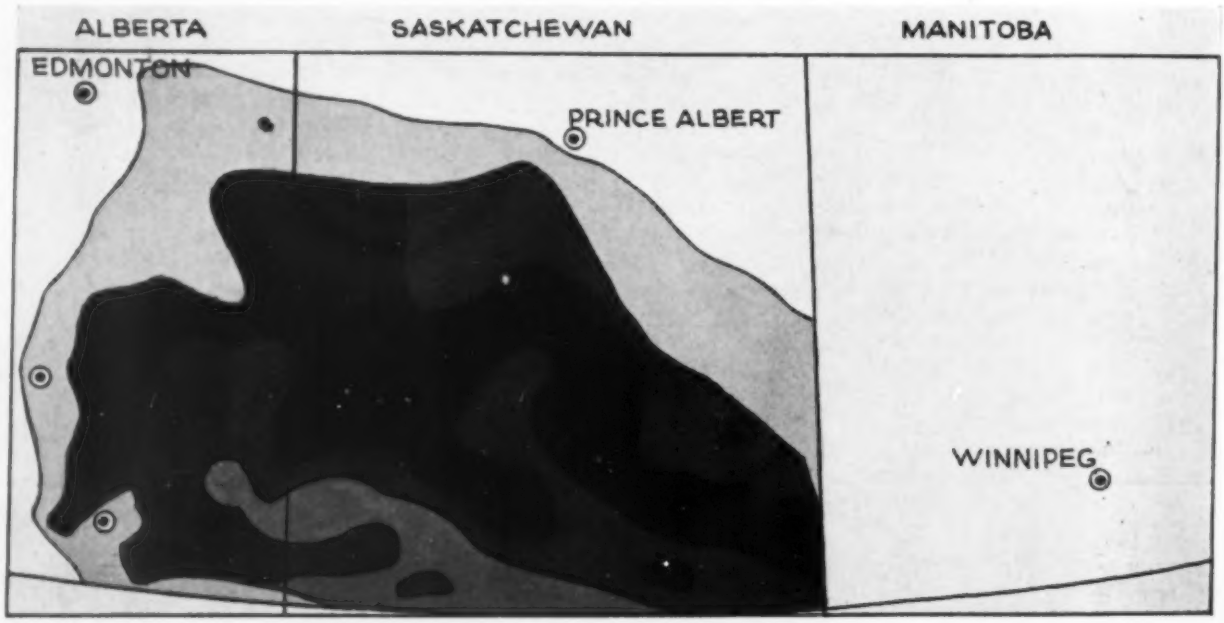
THEORETICALLY, and especially in the minds of most of us who do not have to face the practical problem of actually doing it, the production of wheat for world markets in the Canadian Prairies is supposed to be little short of an agricultural idyll. In actual practice, however, the production of this crop in Western Canada upon a profitable basis is far from the simple programme of breaking the sod, seeding, harvesting and selling the crop. The successful production of wheat in the Canadian West in fact is carried on against a procession of crop hazards probably unequalled in their intensity in connection with the production of any other major crop in the national economy. Dr. L. H. Newman, in his article in this number of the Canadian Geographical Journal, indicates the solution of the very important frost problem by the production of early varieties of wheat and describes the progress in disposing of the very serious limitation on wheat production inherent in the rust problem.

Another of the truly major crop hazards is that of the widespread and destructive occurrence of insect pests. They are both periodic and annual in their occurrence in injurious numbers and though very happily they are among the controllable crop production problems they constitute a very serious burden, both psychic and economic, upon the wheat production on the prairies. As an annual economic drain upon agricultural production, insects in general are responsible for a loss of probably not less than 10 per cent of the crop. However, in a year of serious grasshopper outbreak, were not the most widespread and vigorous control measures undertaken by the farmer under the leadership of governmental agencies, there is little question but that in the Prairie Provinces at least 75 per cent of all crops, wheat, coarse grains and fodder crops would be destroyed.

In addition to the actual lowering of the yield by direct destruction of crop, insects must be charged with a waste of seed, labour and time, not to speak of the generally lowered value of a replanted crop and the monetary cost involved in the fighting of control campaigns. Actual monetary cost specially characterizes grasshopper control work and this varied from $100,000 to $750,000 a year between 1932 and 1938. The loss of time by farmers is relatively enormous, especially in connection with the control of grasshoppers when in violent outbreak. These control campaigns require that tens of thousands of farmers throughout the Prairie Provinces spend at least two months of the year, to some extent actually personally engaged in control work, not to mention the enforced withdrawal from more productive operations of scores of public officials both provincial and municipal engaged in the organization and







Top:—Sketch map of forecast of grasshopper outbreak in 1934.
Centre:—Sketch map indicating probable distribution of pale western cutworm in 1939. Cutworm damage may occur anywhere within broken line if season is dry. Injury by cutworms will be general in black areas unless the season is very wet.
Bottom:—Sketch map of distribution of wheat stem sawfly in Saskatchewan and Alberta indicating in density of shading the relative severity of infestation.

administration of the campaign. Apart entirely from the simple loss of time, the fact that the fight to protect the crop from grasshoppers occurs by natural circumstance in periods of drought when the crop is least able either physically or economically to bear the load, and that at the same time such insects as the pale western cutworm and wireworm, to mention only two, are also either in outbreak form or causing their maximum damage, establishes a psychic load which only the most hardy can sustain and affects the community morale most seriously.

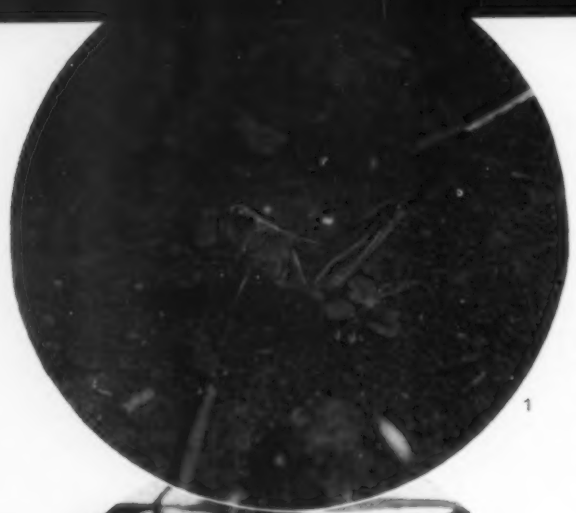
Since the earliest settlement of the West, insects have been a serious problem. The records compiled for Manitoba by the late Norman Criddle indicate that grasshoppers were abundant in 32 years between 1800 and 1930. If to this is added the six years of outbreak subsequent to 1930, there is no doubt of the fact that in the Province of Manitoba at least 38 out of the last 138 years were characterized by abundance of grasshoppers. In addition to grasshoppers the natural vegetation of the prairies supported a varied insect population which, though it seemed innocent enough in the pre-agricultural period, later proved to be of very real consequence. As the settlement of the country took place and the cultivated crops replaced the natural vegetation many of these insects simply transferred from their old host plants to the new man-grown varieties.

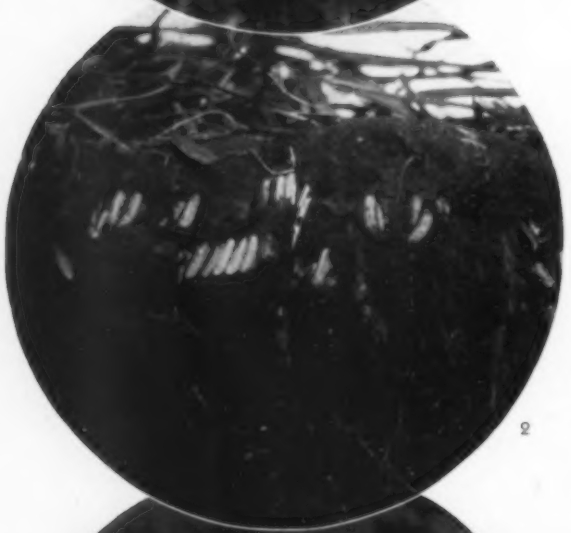
In the settlement of the West, the expansion of crop acreage was so rapid that these native insects which moved over to the cultivated crops were at first a matter of no serious concern. However, many of the native insects found the introduced plants entirely suitable for food and, as these were produced in a volume, distribution, regularity and of a succulence far in excess of the native food supply, living conditions were provided suitable for many insects in vastly greater numbers over an enormously extended range. Not only did the crops themselves prove of advantage to the insects, but the simple fact of the cultivation of the soil and its maintenance over a large proportion of the country in a condition for crop growth, multiplied many times the area suitable for the underground stages of what have since proved to be some of the most injurious species. Thus by the time that the cultivation of the prairies and the park lands to the north had become general, many of the native insects had established themselves as serious pests of cultivated crops. At the present time they constitute so serious a crop hazard as to require consideration in the production of every prairie crop and in the appraisal of the value of every cultural practice.

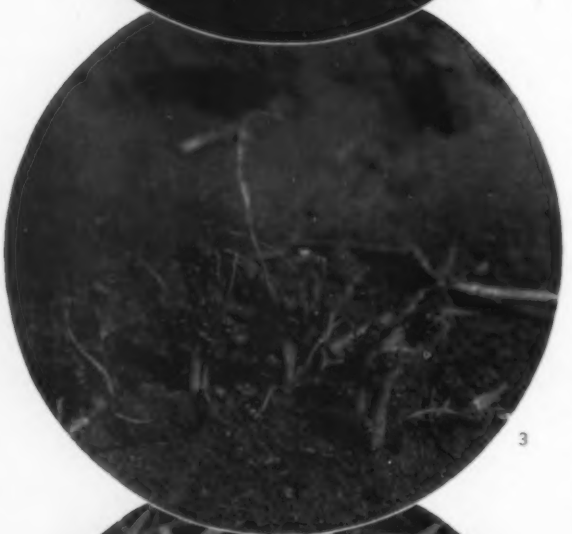
Of the major prairie crops, wheat is the most preferred by insects and is the most susceptible to injury. No part of the plant is free from attack by one insect or another. The seed in the ground may be devoured by wireworms before it even germinates. The young plants as they come through the ground may be devoured just below the soil surface by wireworms, pale western cutworms or red-backed cutworms. Such young plants as manage to get well above ground may be nipped off by any of several varieties of cutworms such as the red-backed cutworm, the early cutworm, the army cutworm or by one of the several varieties of grasshoppers which may be present. Nor are these attacks confined to the young plants. Certain of the cutworms continue to feed with destructive effect for three or four weeks and in the case of grasshoppers feeding continues from the time the wheat pushes through the ground until it is ripe. Just as the plants are coming into head they may be attacked by the wheat stem sawfly. The immature stage of this insect lives in the stem which it tunnels throughout its length and at last, just before harvest time, cuts it off at about ground level. Finally, as though to remedy an entomological oversight upon the part of Canadian insects, one new to Canada arrived within the last few years, known as Say's grain bug, which attacks the developing kernels in the wheat head itself just before it ripens.

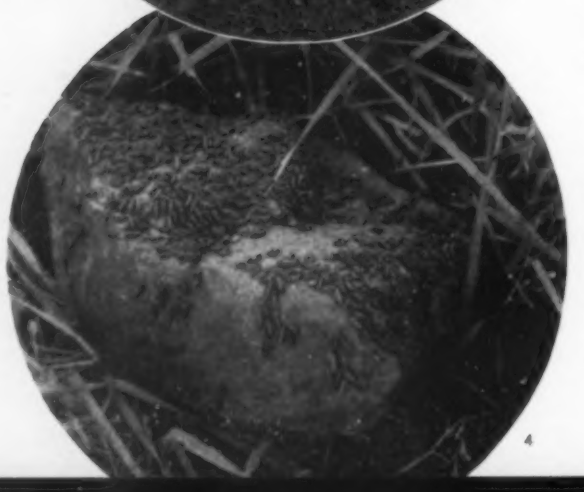
The insects mentioned above do not by any means exhaust the list of those which attack the wheat plant. They do, however, include those of major importance, the control of which by the western farmer is essential to the profitable production of the crop.

In contrast to the scale of insect outbreaks in agricultural crops in Eastern Canada in general, the insect situation of the wheat growing region of the West is characterized by the tremendous areas throughout which, as a rule, each of the more important injurious species is distributed and by the large areas usually involved in an outbreak. This general trend is intensified in its effects on crop losses by the tremendous total acreages and more or less contiguous distribution of the plantings of such a crop as wheat. As a consequence, an outbreak of a major insect pest in this crop area is frequently upon









such a scale as to be not only a matter of local and provincial concern but to be of a national significance. A major grasshopper outbreak as that in 1934 for example, if uncontrolled, was quite capable of destroying at least 75 per cent of the wheat crop of all three Prairie Provinces. Such an occurrence would be a national calamity indeed not only from its domestic repercussions arising from the impoverishment of the tens of thousands of prairie farmers but also from the serious disturbance to the internal business life of Canada and the shock to our export trade which would result from the virtual disappearance of our exportable supplies of wheat.

Happily the grasshopper outbreak of 1934 did not go uncontrolled nor is the wheat farmer helpless in defence of his crop against any of the major insect hazards. In general it can be safely said that at the present time the known insect control practices, if intelligently applied, will reduce the potential loss from grasshoppers, pale western cutworm and wheat stem sawfly in any outbreak to but a tithe of the total to be anticipated if no protective measures were available for utilization. Great progress has been made in the studies for the control of wireworms. The losses from red-backed cutworms can be reduced by 50 per cent at least at the present time. The only insect pest for which as yet no material protection of a practical nature under present agricultural practices is available is the recently established Say's grain bug. To date it has been responsible for very little loss to the crop but its injurious activities in the United States suggest that it is an insect of very serious potentialities.

Fortunately insect outbreaks tend, at least in their original appearance as pests, to begin in a rather small way and in restricted localities from which they gradually spread out, or by widespread local increase come to occupy their ultimate range during the course of a few or many years. Thus from the time of appearance of an insect and its development to the point of its becoming a pest of economic importance, opportunity and time are usually available for a search by the responsible agencies for possible methods of control.

Happily the impossibility of each farmer dealing with his own insect problems unaided is recognized by the several govern-

Fig. 1. Female two-striped grasshopper with abdomen in the ground laying eggs (natural size).

Fig. 2. Eggs of roadside grasshopper in position in prairie sod (natural size).

Fig. 3. First stage of roadside grasshopper attacking young wheat plants (enlarged).

Fig. 4. First stage roadside grasshoppers keeping warm on a stone when the weather was too cool for feeding (reduced).

Photographs by R. D. Bird.

mental authorities concerned and, within their natural fields of responsibility, the Dominion, provincial and municipal authorities undertake a positive leadership. This is particularly true in dealing with the wheat — insect problems of the Canadian West. The Dominion Government through its Division of Entomology of the Science Service, of the Department of Agriculture, concerns itself chiefly with the direct studies of the insect with a view to developing control measures and making them known to all interested. Dominion forces also co-operate most closely wherever necessary with the provincial governments especially in major control campaigns. The provincial governments, especially upon the prairies, chiefly concern themselves, through their entomological officers and extension services of their Departments of Agriculture, with the financing, organizing and conduct of the insect control campaigns. These campaigns are carried on either directly by the provincial governmental officials or, as in the case of grasshopper-control, through and with the active participation of the municipal authorities.

In the study of measures for the control of insects every effort is made to have them of the most practical and simple nature, to avoid the necessity for cash outlay, and wherever possible, to have them consist of some change in cultural practices which conforms with the most approved agronomic standards advisable in the area where they are to be used. However, to date, no cultural substitute has been found for the use of poisoned bait in the control of grasshoppers and several species of cutworms, the latter of which, with the exception of the pale western variety mentioned previously, as yet require a direct cash outlay for the ingredients requisite in the poisoning phase of the work.

Of the rather lengthy list of insects attacking wheat in Western Canada, four insects or groups of insects—grasshoppers, the wheat stem sawfly, wireworms, the pale western cutworm and the red-backed cutworm—occur over a sufficient territory annually, or from time to time, with a sufficiently destructive effect to definitely influence the industry. Of other pests attacking the wheat crop none rank in importance with the group listed, and limitations of space restrict reference to them to a mere mention of the fact that other injurious insect species do occur.

Grasshoppers are without question the most spectacular of the insects attacking prairie crops from virtually every point of view. No one who has lived through a season of serious grasshopper outbreak in infested territory in the Canadian West can ever again regard economic insects with indifference. They have been a periodic scourge of the West from the time of earliest record and until 1874 the Canadian outbreaks originated from grasshoppers which flew in from the United States. Since that date, however, although there has not infrequently been some exchange of grasshoppers between ourselves and our neighbours to the south, in general the recent outbreaks have arisen from insects which developed in Canada. Following the last serious outbreak of 1919 to 1923, it was quite widely believed that with the increased cultivation and the reduction of natural prairie that the grasshopper menace would be reduced. This is now felt to be a vain hope and that if any trend is shown it is towards an assurance of a continuation of the recurrent outbreaks, in all probability of an intensity equal to, if not greater than, any heretofore experienced. At the present time, 1939, the western wheat farmer is preparing to face the eighth successive outbreak year of a series which started in 1932.

There are many species of grasshoppers normally present upon the prairies of which not more than six or seven are of economic importance and of these, in the present outbreak, three, the roadside grasshopper (*Camnula pellucida* Scud.), the lesser migratory grasshopper (*Melanoplus mexicanus* Saus.) and the two-striped grasshopper (*Melanoplus bivittatus* Say) have been responsible for virtually the entire crop destruction during the last seven years. The life-histories of all three species are very similar. The winter is passed in the egg stage in the soil. The eggs hatch about the time the poplars are bursting into leaf. The young grasshoppers, just as soon as they hatch, attack the newly sprouted wheat plants and continue to feed upon the growing grain until they are full grown in July. Egg laying begins as soon as the females mature and egg-laying and feeding continue throughout the summer and on into September. The eggs are laid in the soil and each female may lay up to 150 or 200 during the season. In a grasshopper outbreak, such as that which has been in course during the last seven years, the grasshoppers and their eggs are found throughout the entire prairie area from Eastern Manitoba westward for a distance of over 700 miles to the foothills of the Rocky Mountains in Alberta, and as far north as Prince Albert in Saskatchewan and Edmonton in Alberta. The result was that in 1934, when the outbreak had

extended to involve the entire prairie area proper, a territory of some 122,551 square miles or approximately 78,000,000 acres was infested with grasshoppers to some extent and, following the expansion of the outbreak northward in 1938 into the park belt of Saskatchewan and Alberta, it is expected that in 1939 an area of 151,989 square miles or approximately 97,000,000 acres will be embraced in the territory infested. The extent of the outbreak in prospect for any year is gauged by a systematic survey of the grasshopper eggs in the ground throughout the three Prairie Provinces. The results of the surveys are presented in map form and the areas classified in terms of the abundance of eggs and the probable degree of grasshopper abundance the following year. Five categories are recognized; namely, "very severe", "severe", "moderate or threatening", "light and patchy" and "normal". The severe and very severe areas are assured of sufficient grasshoppers to destroy the crop in the normal course of events, and such areas require thorough and complete organization for control if any material proportion of the crop is to be saved.

Control consists in the organized distribution of the poisoned bran — sawdust bait either by hand or by mechanical spreaders in the infested fields and crops. This direct poisoning is supplemented by cultural practices such as deep ploughing of infested fields, surface cultivation of egg-beds, and in the cultivation of summerfallow by the poisoning of the grasshoppers on unploughed strips on which they have been concentrated by the ploughing down of the adjacent vegetation.

That the control activities are successful when properly organized and carried out either upon the individual farm or in whole districts has been demonstrated beyond any shadow of doubt. As examples it may be mentioned that the control campaign in Manitoba in 1933 was estimated to have saved 34,000,000 bushels of all grains, and the campaign of 1934 was estimated to have saved 70,000,000 bushels of all grains in the three Prairie Provinces in addition to saving hundreds of thousands of tons of fodder, while in 1938, in Alberta, it was estimated that the control campaign of the year effected a saving of $30,000,000 worth of crop, reducing the loss from grasshoppers to not more than 3 per cent. All in all, during the last seven years the savings of crop from grasshopper control work must have totalled several hundreds of millions of bushels of grain not to mention the savings of other crops.

The wheat stem sawfly (*Cephus cinctus* Nort.) lived originally in the native grasses and spread from them to the cultivated crops. Of these it attacks all varieties of wheat as well as oats, barley and rye. Injury of economic importance, however, only occurs in wheat of which this insect is a very serious pest. It is responsible for an annual loss of several millions of bushels of wheat in Saskatchewan and Alberta and though it occurs in Manitoba, of late years it has been of minor concern in this province. The loss in Saskatchewan for example in 1936 was estimated at $3,940,000. As a pest of wheat its importance has been greatly intensified in the last few years in connection with the establishment of strip farming practices arising as part of the effort at wind drift control. In this change in cultural practice the growing of wheat in relatively narrow strips exposes the crop to a greatly intensified degree of infestation. The insect, a small, black, wasp-like, four-winged form, approximately one-half inch long, spends the winter in the grub stage in stubs of the cut-off grain at or just below the surface of the ground. It matures during the latter half of June and flies from the infested stubble of the former crop to the plantings of the year. The eggs are laid in the stems of the wheat and other host plants just as they are coming into head. The grubs which hatch from the eggs feed on the inside of the plant and tunnel down through the stem and just as the grain ripens, they so weaken the stalk that it breaks off at or near the surface of the ground. The tunnelling in the stem reduces both the yield and grade of the wheat and a great proportion of the broken stems cannot be recovered in harvesting operations with ordinary farm machinery.

In the control of this insect advantage is taken of the fact that the insect lives in the wild and cultivated grasses as well as in the cereals and lays its eggs only in stems of the plants which have developed to the stage of being hollow. Hence the chief control measures are to plant only on uninfested land and to surround the wheat to be protected from this insect by a strip of early sown wheat, oats or an early blooming grass, preferably brome grass, which comes to the favoured stage for egg-laying before the crop wheat. The insects in passing from the infested stubble to the crop proper encounter the barrier of more advanced plants known as a trap crop, lay their eggs therein and thus are drawn away from the main field. A most important feature of the control is to avoid planting the main crop on old infested

stubble. Ultimately it is hoped to have all prairie headlands and roadsides planted to brome grass or some other suitable perennial trap crop when it is felt that economic control will be more or less automatic. The trap crop method of control has been most effective where utilized upon individual farms and its trial upon a community wide basis is under demonstration.

The pale western cutworm (*Agrotis orthogonia* Morr.) is a native insect of the prairie area. It attacks almost any prairie crop with injurious effect, but it is particularly destructive to wheat. It is present in menacing abundance over a vast area in Saskatchewan and Alberta (see map) and in each of the years 1930 to 1932 and 1934 and 1935 was responsible for the destruction of tens of millions of bushels of wheat as well as other crops. The infestations have continued upon a substantially equally vast scale during 1936 to 1938, but the losses were reduced to but a fraction of those formerly sustained by the widespread application of control measures. The adult stage of this insect is a moth which lays its eggs in loose dusty soil during the last half of August and the first half of September. The eggs hatch in the spring just after the frost comes out of the ground and the young cutworms attack the wheat just as soon as it germinates, continuing to feed upon it for several weeks. For a short period the cutworms remain above the soil surface, but the greater proportion of the larval stage is spent below ground where, until the middle of June, they feed chiefly upon the underground parts of the plants. When full grown they pupate in the soil and emerge as moths about the first week in August.

In control of this insect advantage is taken of the fact that it lays its eggs only in loose friable soil and that, if when it is very small, its food supply is withdrawn for a period of ten days after it has begun to feed and develop, it will starve to death. It happens also that the probable area to be infested in any year is susceptible of being forecast in July preceding the outbreak. Thus following the publication of the forecast of areas likely to be infested the next year, farmers are advised through the press to have summer-fallow properly prepared by August so as to be able to

9

10

11

12

Fig. 9. The grain crop on the bare field on the left was completely destroyed by pale western cutworm.
Photograph by H. L. Seamans.

Fig. 10. Typical appearance of wheat field severely damaged by pale western cutworm.
Photograph by H. L. Seamans.

Fig. 11. Wireworm larvae (natural size).
Photograph by K. M. King.

Fig. 12. Adult of Say's grain bug resting on wheat head (natural size).
Photograph by H. L. Seamans.

maintain a crust between August 1 and September 15 upon the land to be cropped the following year. This crust makes the land unsuitable for egg-laying and normally free of cutworms the next year. If for any reason a field is suspected or is known to contain cutworm eggs in the spring, the young cutworms can be starved out and the field left safe for planting. This is done by allowing the weeds to grow until they are approximately an inch and a half high, cultivating them out thoroughly and seeding the crop after an interval of ten days. In the interval between the cultivation of the weeds and the germination of the crop the young cutworms which have started to feed and develop on the weeds will have died by starvation. These two control practices have been very widely adopted throughout the most severely infested areas and have virtually eliminated the major proportion of the crop losses on the prairies as a whole, and especially wherever serious attention has been given to the control of this pest.

Wireworms, of which the prairie wireworm (*Ludius aeripennis destructor* Brown) is the most important species, are native prairie insects. The cultural practices ordinarily used in wheat production have apparently created conditions suitable for their spread and increase in numbers. As a result these insects have become one of the most destructive annual pests of wheat over the greater proportion of agricultural Saskatchewan and a large part of Alberta. The numbers are slowly increasing with continued culture in much of the area and in the central prairies a substantial acreage has been withdrawn from cultivation on account of the persistent severity of their damage. It is estimated that in 1938 these insects were responsible for a reduction of 20 per cent of the yield of crop in Saskatchewan. The crop injury due to these insects is caused by the immature stage which lives underground and there feeds upon the seed both before and after germination and on the underground stems and roots; most of the damage being caused while the plants are small. The adult wireworm is a beetle which lays its eggs in the ground. The larvae hatching from them have very short legs and are yellowish, hard and more or less cylindrical and grow to a length of about an inch. Their hard texture naturally gives rise to their common name. They grow very slowly and may spend five or more years in the ground before becoming mature. The problem of the control of these pests is as yet far from a complete solution in spite of continuous and vigorous study. Material progress in the investigation, however, has been made and knowledge is available in respect to cultural practices which will very definitely reduce the effect of these insects. Of these practices the most useful are to seed heavily, plant only when moisture conditions are favourable and on ploughless and weedless summer-fallow. The use of superphosphate fertilizers in the early season on wheat in certain districts has been useful and has made possible the production of a crop up to the limit allowed by the moisture supply in spite of the presence of wireworms.

The red-backed cutworm (*Euxoa ochrogaster* Gn.) is another native prairie insect which upon occasion is very destructive to wheat, especially along the northern edge of the prairie and in the park belt. It is usually active as a crop pest in periods of favourable moisture conditions and although it has been of little widespread concern for some years, it caused a loss of crop in Saskatchewan in 1925 of a value estimated at $4,000,000. Its life-history in general is comparable to that of the pale western cutworm. The methods of control, however, in use for this insect during the last outbreak were entirely different and the most effective procedure available proved to be the poisoning of the cutworms in infested fields by the use of poisoned bran bait. This control is not satisfactory as a permanent solution of the problem either in effectiveness or convenience in prairie insect control work. It has the great disadvantage of requiring the expenditure of money for materials. It is expected, however, that the progress made in pale western cutworm control since the last outbreak of the red-backed species may assist in devising a cultural programme for use with the latter. The test of this possibility awaits the occasion of the next outbreak of the red-backed cutworm, which from the point of view of the wheat crop and the farmer, it is sincerely hoped will be long delayed.

If in focusing attention upon insects as a factor in wheat production the note of hazard has been unduly emphasized, the reader is reminded that they are controllable and that, more and more, the practices necessary for the protection of the crop are being incorporated into the production routine of western farms.

PERMANENCY

Beneficiairies of estates find our personal service particularly comforting. The Royal Trust Company is not a factory—cold and mechanized—but a group of skilled and very human individuals deeply interested in the problems of our clients. While individual service is enjoyed; the estate has that protection which only a corporate executor can give—permanency. A Trust Company does not die, is never ill nor absent when needed.

THE

ROYAL TRUST

COMPANY

ZEISS

Zeiss Sportur

The high light transmitting power, the large field of view, the rapid adjustment by centre-wheel focussing all combine to make the SPORTUR one of the most popular of the new ZEISS Featherweight Models. **PRICE $52**

See your nearest Dealer, or write for illustrated pamphlet

EM

Canadian Distributors
HUGHES OWENS CO. LIMITED
MONTREAL · TORONTO · OTTAWA · WINNIPEG

EDITOR'S NOTE-BOOK

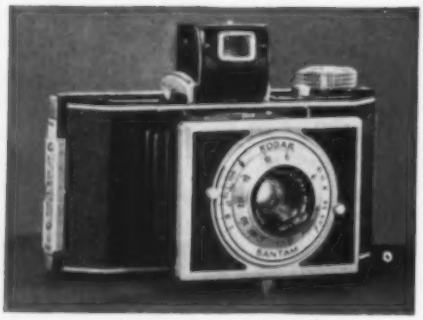
Dr. L. H. Newman, who has been Dominion Cerealist, Department of Agriculture, Ottawa, since 1923, is known throughout Canada for his work in developing new varieties of wheat and other grains. He is a graduate of the Ontraio Agricultural College and took special studies in plant breeding at the Iowa State College at Cambridge University and in Sweden. The University of New Brunswick conferred on him the honorary degree of Doctor of Science.

H. G. Crawford is in charge of Field Crop Insect Investigations in the Division of Entomology, Science Service of the Dominion Department of Agriculture. He is a graduate of the Ontario Agricultural College with post-graduate training at the University of Illinois. His professional work since 1920, both investigational and administrative, has been entirely with field crop insects. The studies carried on by the entomologists associated with this work in the Departmental Entomological laboratories at Brandon, Saskatoon and Lethbridge provided authoritative knowledge on which Mr. Crawford based his article "Insects as a Factor in Wheat Production on the Canadian Prairies."

KODAK
BANTAM SPECIAL

Lens, Kodak Anastigmat EKTAR *f*.2.0, extra-fast, super-corrected. Shutter, 1/500 Compur-Rapid. Built-in range finder of the split-field military type finds the range and focuses in one operation. The low price includes sportsman's field case. $97.50

KODAK BANTAM *(f.4.5)*



Fine, fast Kodak Anastigmat Special *f*.4.5 lens, 1/200-second shutter. Self-erecting front. Plunger-type body shutter release. Folding optical eye-level finder. Automatic film-centering mechanism. Now at a new low price. $25

FOR FULL COLOUR with these miniatures, just load with Kodachrome Film.

KODAK BANTAM FAMILY also includes Kodak Bantam *f*.5.6, for both black and white and Kodachrome, which is priced at $16, and two lower priced Kodak Bantams, the *f*.6.3 model at $9.50, and the Doublet lens model at $5.75, both for black-and-white pictures only. At your dealer's.

IN CANADA "KODAK" IS THE REGISTERED TRADE MARK AND SOLE PROPERTY OF CANADIAN KODAK CO., LIMITED, TORONTO.

FREE *Write for Booklet*
NEW 1939 VARIETIES
WINCO Roses

Enjoy the thrill of growing lovely new roses. Send for FREE 16-page color illustrated booklet showing 1939 varieties with complete cultural information. Write today.
WINONA NURSERY COMPANY
Dept. L, Winona, Ontario
SOLD BY LEADING NURSERYMEN AND DEALERS

Just Out!
1939 EDITION of
AMERICAN ALPINE JOURNAL
a review exclusively devoted to
MOUNTAINEERING
150 pages of text, 35 pages of unique photographs including
HIMALAYAS • ALASKA • ALPS
CANADIAN ROCKIES
AMERICAN ALPINE CLUB
(Founded 1902)
140 East 46th Street New York
SEND $1.00 for your copy. Supply Limited—Write Today!

SANDEMAN

Port and Sherry
SANDEMAN

Famous Medals
for Distinguished Service...

THE DISTINGUISHED FLYING CROSS... 1918

Awarded to Officers and Warrant Officers of the Air Force for valour, or devotion to duty in active operations against the enemy, this coveted decoration was instituted on June 3, 1918, by King George V, when it was felt that decorations awarded to other arms were not appropriate for the then new flying branch of the fighting service. From a distinctive blue and white diagonal striped ribbon is suspended a beautiful silver cross as shown. Bars are awarded for subsequent acts and rosettes are worn on the ribbon when the ribbon is worn without the cross in undress uniform. Recipients are permitted to use the letters D.F.C. after their names.

Over 60 Medals and Prizes awarded Dewar's for merit...

The highest honours the world has ever bestowed upon a Scotch Whisky !

DEWAR'S

Special Liqueur **OLD SCOTCH WHISKY**

BY APPOINTMENT

DISTILLED, BLENDED AND BOTTLED IN SCOTLAND BY **DEWAR**

YELLOWKNIFE SHOWS RAPID GROWTH

Yellowknife, Northwest Territories, was the most actively prospected gold area in Canada during 1938, according to the Department of Mines and Resources, Ottawa. More than thirty mining and prospecting companies were active in the Yellowknife area, as well as scores of individuals, syndicates and groups. Some 3,500 claims were filed during the year, bringing the total number of claims in the Yellowknife region up to about 5,500.

The highlight of the year's activities at Yellowknife was the entry into production of the gold milling plant at the Consolidated Mining and Smelting Company's "Con" property, which marked the start of commercial gold production in the Northwest Territories. Another significant feature was the milling at this plant of one ton of ore brought in by airplane from an independent property at Pensive Lake, a distance of fifty miles from Yellowknife. At the Negus Mine's property, Yellowknife's second gold milling plant was erected and is about ready to enter production. Active development work was carried on at several other properties in Yellowknife and vicinity, while the intensive field work of prospecting and exploratory parties in areas to the north and east yielded a number of likely finds.

A thriving settlement of more than one thousand people has sprung up at Yellowknife Bay, attracted by the mining development which has taken place during the past three or four years. Last year a 40-acre townsite was surveyed and subdivided into 125 lots. The townsite now contains forty buildings, and a government radio station maintains constant communication with the outside. Yellowknife is about 800 miles by air from Edmonton, and 690 miles by navigation from Waterways, the end of steel.

Government,
Municipal, Public Utility
and
Industrial Bonds

◆

List of current offerings furnished on request

NESBITT, THOMSON
& Company, Limited

355 St. James Street West, Montreal

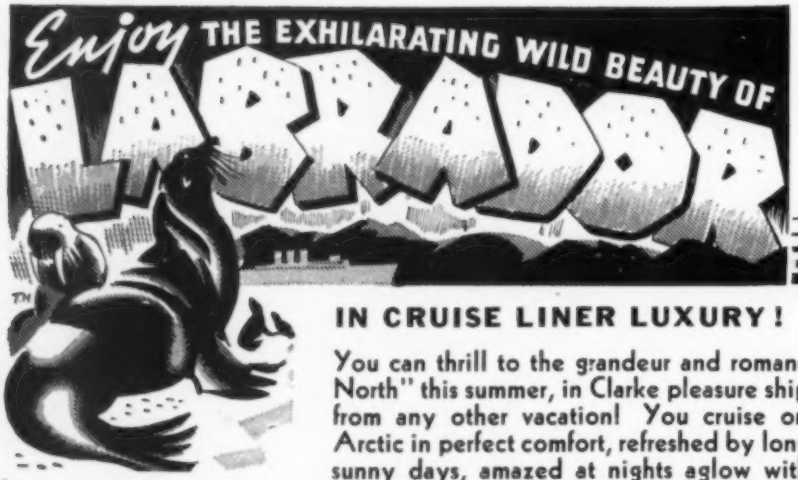
Branches in the principal cities of Canada

Everything
in Printing

FROM THE IDEA TO THE FINISHED JOB

Canadian Printing and Lithographing Co. **is completely equipped to prepare and produce all classes of printing, including Magazines, House Organs, Calendars, Catalogues, Broadsides, Booklets, Folders, and Leaflets.**

CANADIAN PRINTING *and* LITHOGRAPHING COMPANY LIMITED
2151 Ontario St. East, Montreal
Telephone FR. 2111



IN CRUISE LINER LUXURY!

You can thrill to the grandeur and romance of the "Golden North" this summer, in Clarke pleasure ship luxury. Different from any other vacation! You cruise on the edge of the Arctic in perfect comfort, refreshed by long, mellow Northern sunny days, amazed at nights aglow with Northern Lights. You see icebergs, strange wild life, nomad Indians; visit famed Grenfell Mission, remote settlements, historic ports. Also Newfoundland, Gaspe, French Canada, Acadia, etc. Your ship's your superb hotel all the while: all outside rooms, gay ship life with new friends, best French cuisine and service.

Mid-season cruises
from Montreal, 11-12½ days, $135. up

from New York, 11½ days, $145. up

Special low rates for June and September cruises.

Ask your Agent today for literature, or apply

CLARKE STEAMSHIP CO., Ltd
Canada Cement Building - Montreal

"NORTH STAR" "NEW NORTHLAND"

CLARKE *Steamship Co~Limited*